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Volume 26, Number 23, December 15, 1972

NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of international nuclear science literature. *Nuclear Science Abstracts* covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted:

NEWCOMB, William A., Stability of a magnetic well, 25:1239
NEWKIRK, L. R., Superconductivity in the pseudobinary alloys V_3Si--Nb_4Al, 25:1093 (CALT-822-13)
NEWLAND, E. A., Radiation treatment of sewage, 25:140 (AAEC/LIB/Bib-254)

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

TRANSURANIUM ELEMENTS
  determination in bone ash, radiochemical method for, 25:40 (IDO-12073, pp 28-36)
  separation by ion exchange and complex-formation elution, 25:251(P)

TRIETHYLENETETRAMINE
  complexes with cobalt(III) and rhodium(III) chlorides, radiation effects on labeled, thermal-neutron, 25:137
TRITIUM
  content in Cattaraugus Creek near West Valley Processing Plant, July through Dec. 1969, 25:258 (DOCKET-50201-48)
  content in Cattaraugus Creek near West Valley Processing Plant, Jan. to July 1970, 25:259 (DOCKET-50201-49)
  determination in luminescent material by scintillation counting, 25:40 (IDO-12073, pp 28-36)

Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

372 (UCRL–72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009–1). Dep. NTIS.

is indexed as:

CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
  Construction of a unique underground whole body counter, 25:372 (UCRL-72739)

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 55943, 56235, 56269, 56278, 56279, and 58075.

55643 (COO-2169-1) ANALYTICAL METHODOLOGY FOR ENVIRONMENTAL MEASUREMENTS. Final Progress Report. Hume, David N. (Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry). 31 Jul 1972. Contract AT(11-1)-2169. 21p. Dep. NTIS.

Scientific accomplishments in the areas of complex ion chemistry, analytical techniques and methodologies, and other chemical studies achieved during the 22 year period of this contract and its predecessors are summarized. Reference is made to 94 scientific papers resulting from the work. (M.C.G.)

55644 (HASL-300) HASL PROCEDURES MANUAL. Harley, John H. (ed.) (Health and Safety Lab. (AEC), New York). 1972. 602p. Dep. NTIS.

First issued in 1957 as NYO-4700.

The manual contains procedures that are used currently by the Health and Safety Laboratory of the U. S. Atomic Energy Commission. Sections included are: sampling, field measurements, radiochemical and radiometric analysis, chemical procedures, data section, and specifications. (D.H.M.)

55645 (JAPFNR-59) RESULTS OF THE COOPERATIVE ANALYSIS OF SODIUM. (Japan Atomic Energy Research Inst., Tokai). Translation of a Japanese report. 17p. (PNC-J-250-72-3). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan).

A by-pass loop sampler for preparing sodium samples was designed and installed. The sampler consists of three parts, i.e., a glovebox, cover gas purifier, and U shape stainless steel tube. By using this sampler, 9 sodium samples were taken after flushing with sodium for two hours at 350°C. The sodium samples were analyzed for oxygen, carbon, and metallic impurities by 14 laboratories of the Subcommittee on Analysis of Sodium. Analytical results and evaluation of the cooperative analyses were described. (auth)

55646 (K-L-6301) URANIUM ISOTOPIC WORKING STANDARDS. Wertz, R. J. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 22 Sep 1972. Contract W-7405-eng-26. 5p. Dep. NTIS.

UF_6 is usually blended to make standards that weigh in excess of 100 g. When smaller standards are required, they are generally prepared by blending U_3O_8. Primary generative, secondary generative, base standards, and working standards are discussed. A series of 135 working standards ranging from 0.13 to 97 wt % ^{235}U is maintained. The ^{235}U concentration is known to be ±0.1% relative to the NBS standards. These standards are available on request through the USAEC. (M.C.G.)

55647 (STI/PUB-291) ANALYTICAL METHODS IN THE NUCLEAR FUEL CYCLE. Proceedings Series. Proceedings of a Symposium Held in Vienna, 29 November-3 December, 1971. (International Atomic Energy Agency, Vienna (Austria)). Apr 1972. 595p. (In French and English). (CONF-711107). IAEA $18.00.

Forty-two papers and discussions of these papers are included. Separate abstracts were prepared for 30 papers. The remaining 12 papers were previously abstracted for NSA. For abstracts of these papers see CONF-711107 in the Report Number Index. (M.C.G.)

For abstracts of individual papers see: 55693–55709, and 55746–55758.

55648 CHELATES IN ANALYTICAL CHEMISTRY. A COLLECTION OF MONOGRAPHS. VOLUME 3. Flaschka, H. A.; Barnard, A. J. Jr. (eds.). New York; Marcel Dekker, Inc. (1972). 241p. $19.75.

Topics covered include: extractive titrations involving chelates and chelating agents by Aftanas Galik; amperometric titrations involving chelates and chelating agents by Jan Doležal, Kareb Štulik, and Jaroslav Zýka; and electroanalytical methods in the study of chelation reactions by M. Kopanica and J. Zýka. (M.C.G.)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 56333 and 56784.

55649 (CEA-R-4339) RADIOACTIVE ACTIVATION ANALYSIS AND DIETETICS. Fourcy, Andre; Baquey, Michel; Neuburger, Michel; Plebin, Roger; Rigot, Jean (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jul 1972. 13p. (In French). Dep. NTIS (U. S. Sales Only).

Neutron activation analysis can be used to analyze human and animal dietetics. The minerals required by the organism are investigated. A completely sufficient diet intended for man was investigated. Major elements such as N, P, K, and Ca and oligo-elements such as Fe, Zn, Co, and Mo were found. Another aspect of the work was the establishment of the existence of toxic elements, difficult to determine by other methods: arsenic, bromine, selenium, and mercury, etc. Elements present in the trace state or incorporated in the food material provided useful information. The predicting of the effects of radioactive products incorporated in the food system is envisaged from the analysis of stable elements corresponding to the radionuclides. The introduction of harmless tracer elements, e.g. Cs, is discussed. It is possible to identify food products from their microelement contents, the La series of elements being particularly useful for this purpose. (France)

55650 (NBS-TN-467) ACTIVATION ANALYSIS: A BIBLIOGRAPHY THROUGH 1971. Lutz, G. J.; Boreni, R. J.; Maddock, R. S.; Wing, J. (eds.) (National Bureau of Standards, Washington, D. C.). Aug 1972. 892p. GPO $7.00.

This is the fourth issuance of a bibliography that first appeared in 1968. The references total ~6200. The bibliographical entries, identified by accession numbers, are given. Access to the references is given through author, element determined, matrix analyzed, and technique utilized indexes. (M.C.G.)

55651 YADERNOFIZICHESKIE METODY ANALIZA VESHCHESTVA. (Nuclear-Physical Methods in the Analysis of Materials). All-Union Scientific Conference on Twenty Years of Production and Utilization of Isotopes and Sources of Nuclear Radiation in the National Economy of the USSR, Minsk, October 1968. Alimarin, I. P. (ed.). Moscow; Atomizdat (1971). 496p. (CONF-681061-(Pt.1)).

This collection of 92 articles by various authors discusses the use of radiometric analysis in scientific investigation and industry with a wide range of examples of techniques, types of samples, and with numerous variants: neutron absorption, photonuclear methods, radiation capture, x ray radiometric methods, and γ-resonance spectroscopy. Neutron activation analysis comprises the majority of the developmental work reported. Special techniques presented, other than neutron activation, include a proton recoil method, activation analysis by various charged particles, non-elastic scattering of γ quanta, the use of a linear accelerator for production of 4.2-MeV electrons, and photoneutron methods. (K.S.W.)

55652 GELATIN AS A MATRIX FOR A MERCURY REFERENCE MATERIAL. Anderson, D. H.; Murphy, J. J.; White, W. W. (Eastman Kodak Co., Rochester, N. Y.). Anal. Chem.; 44: No. 12, 2099-2100(Oct 1972).

Since gelatin contains trace quantities of the elements encountered in the determination of Hg in plant and animal tissue, it appears suitable for use as a reference for determining Hg in biological substances. Gelatin for use as Hg reference material was prepared and analyzed for Hg by atomic absorption and neutron activation. (J.G.B.)

55653 DETERMINATION OF SILVER IN PRECIPITATION DOWN TO 10^{-11}M CONCENTRATIONS BY ION EXCHANGE AND NEUTRON ACTIVATION ANALYSIS. Warburton, Joseph A.; Young, Lawrence G. (Desert Research Inst., Reno). Anal. Chem.; 44: No. 12, 2043-5(Oct 1972).

Thermal neutron activation analysis was used to determine the concentration of silver in precipitation. The reaction ^{100}Ag(n,γ)^{110}Ag was used, the determinations being made by γ spectrometry using the 24-sec half-life ^{110}Ag radioisotope. The silver content of precipitation in the eastern Sierra of the United States was generally in the concentration range of 2 to 6 × 10^{-11}M. Evidence indicates that this natural "background" concentration of silver increases by a factor of 10 east to the Rockies. Samples collected in mountainous areas where silver iodide is being released for weather modification purposes contained silver in concentrations as much as 2 × 10^{-7}M. To effect detection of silver at these low concentrations, sample enrichment by ion exchange was used prior to activation. (auth)

55654 RATIO MATCHING: A STATISTICAL AID FOR DISCOVERING GENERIC RELATIONSHIPS AMONG SAMPLES. Anders, Oswald U. (Dow Chemical Co., Midland, Mich.). Anal. Chem.; 44: No. 12, 1930-3(Oct 1972).

A technique of matching the ratios of elemental concentrations of a sample with the equivalent ratios of other samples is described. The resulting correlations are indications of potential generic relationships among the samples. Experimental data based on 91 sediments analyzed for eight elements by neutron activation analysis are used to demonstrate the ability of the method. Three typical examples show the relatively high correlations achieved between samples for which close generic relationships could be explained, post facto, by geographical evidence. The elements determined are As, Sb, Cu, Zn, Au, Cd, Hg, and Cr. (auth)

55655 MEASUREMENT OF DISTRIBUTION OF CHARGED METAL IN THE MOLD BY ACTIVABLE TRACER METHOD. Kawamoto, Jun-ichi; Ito, Yasuo (Toyota Central Research and Development Labs., Inc., Nagoya, Japan). Radioisotopes (Tokyo); 21: No. 8, 482-6(Aug 1972). (In Japanese).

The distribution of molten metal in a mold was investigated by an activable tracer method. Au and Ir were used as the tracer elements, which were not originally included in the casting material and highly sensitive to the neutron activation method. In the preliminary experiment with a simpler mold, it was revealed that a 0.005% addition was sufficient for either Au or Ir to be fully detected after 5 hr irradiation with a neutron flux of 2 × 10^{11} n/cm^2/sec, followed by 24 hr of cooling. The sampling for radiation detection should be carefully made because of the incomplete mixing state of molten metal even in a preferred area. The mold in the experiment was a sand mold for the production of a cylinder head of an automotive engine. Molten metal was poured in three charges. The first charge contained Au, the second Ir, and the third no tracer. About 10 g of sample was taken from each appropriate part of the casting, and subjected to irradiation by neutrons with a flux of 2 × 10^{11}n/cm^2/sec. The content in percent of the first and second charges was determined from the measurement of the photo-peak area of gamma rays at 0.41 (Au) and 0.31 (Ir) MeV, respectively. The remainder was assigned to the third charge. Results indicated that the first charge settled in the lower part of the mold, farthest from the sprue runner. The second and third charges tended to solidify in upper layers. However, some degree of mixing by convection was observed in some parts of the mold. (auth)

55656 SUM PEAK COINCIDENCE METHOD FOR ACTIVATION ANALYSIS. Sriramadas, A.; Lakshminarayana, V. (Andhra Univ., Waltair, India). Curr. Sci. (India); 41: No. 18, 671-2(20 Sep 1972).

The sum peak coincidence method has a higher efficiency and better resolution characteristics than conventional spectrometer arrangements. The details of the arrangement with reference to the estimation of manganese in geological samples are given. The sample is sandwiched between 2 NaI(Tl) crystals attached to photomultipliers. The output of the two photomultipliers is passed through cathode followers and a summing circuit, amplified, analyzed on a 100-channel analyzer, and counted. Coincidence summing is not used and the summing is merely employed to enhance the geometric efficiency. (M.C.G.)

55657 DETERMINATION OF RHENIUM IN MOLYBDENITE CONCENTRATES BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS WITH ^{252}Cf AS NEUTRON SOURCE. Linn, T. A., Jr. (Kennecott Copper Corp., Salt Lake City)- Byrne, J. M.; Sandquist, G. M. Contract AT(38-1)-619. Anal. Chim. Acta; 61: No. 2, 303-6(Sep 1972).

Samples of molybdenite concentrates were prepared and ^{252}Cf irradiations were made for 16 hr at a flux of 1.5 × 10^8 n cm^{-2} sec^{-1}. After a cooling period of 4.5 hr, γ spectra were collected using a 40-cm^3 Ge(Li) detector coupled to a 1024-channel analyzer. Typical spectra of samples and standards are shown. The limit of the detection of the method is about 15 ppM rhenium at 95% confidence. (M.C.G.)

55658 NEUTRON ACTIVATION ANALYSIS FOR EUROPIUM IN PHOTOGRAPHIC FILM. Adams, F. (State Univ., Ghent); Bouten, P. Anal. Chim. Acta; 61: No. 2, 307-10(Sep 1972).

Analysis were made of photographic film for the activable tracer europium by neutron activation. Irradiations were performed at a thermal neutron flux of 10^{11} n cm^{-2} sec^{-1}. Separation of the ^{152m}Eu activity from the matrix was based on the precipitation of the silver halides and of europium oxalate. (M.C.G.)

55659 DETERMINATION OF IODINE IN MATERIALS OF BIOLOGICAL INTEREST. A COMPARATIVE EVALUATION OF NEUTRON-ACTIVATION AND AUTOMATED COLORIMETRIC METHODS. Malvano, R. (CNR, Pisa, Italy); Buzzigoli, G.; Scarlattini, M.; (and others). Anal. Chim. Acta; 61: No. 2, 201-22(Sep 1972).

Two microanalytical methods for determination of iodine in material of biological interest were studied: neutron activation analysis and automated colorimetry (iodide catalysis of the As(III)—Ce(IV) system). The methods were applied to the analysis of samples of water, biological fluids, common salt, and solid substances such as tissues, stools, and foods. The particular procedures set up and optimized for the different substances with both methods are described and discussed, and the respective advantages in terms of sensitivity, accuracy, precision, and speed are compared. The sensitivity and accuracy of both techniques were found to be quite adequate. Automated colorimetry is to be preferred for its precision and operative simplicity, while activation analysis retains full validity as a reference check method. (auth)

55660 SENSITIVE METHOD FOR THE ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF CHLORIDE. Belcher, R.; Rodriguez-Vazquez, J. A.; Stephen, W. I. (Univ. of Birmingham, Eng.). Anal. Chim. Acta; 61: No. 2, 223-32(Sep 1972).

A method for the determination of chloride ion is based on the formation of phenylmercury(II) chloride, its extraction into chloroform, and reaction with sodium diethyldithiocarbamate to form phenylmercury(II) diethyldithiocarbamate. This complex has spectral maxima at 257 and 297 nm, either of which can be used for quantitative purposes. The molar absorptivities are 21.3 × 10^3 and 6.5 × 10^3 respectively, referred to the chloride ion. The method is especially suitable for the determination of trace amounts of chloride in aqueous solution and has been applied to samples of drinking water. Amounts of chloride in the range 0.04 to 0.32 ppM can be determined in 250-ml aqueous samples with an average relative mean error of 12%. The method can be used also for bromide and iodide, and for organomercury(II) compounds. Interferences are minimal and the method compares favorably with the standard mercury(II) thiocyanate procedure. (auth)

55661 THEORY OF SELF-CONSISTENT INTERPRETATION OF SPECTRA IN ACTIVATION ANALYSIS. Zinov'ev, N. V.; Mukhamedshina, N. M. At. Energ. (USSR); 33: No. 1, 589-90 (Jul 1972). (In Russian).

Successful application of large electronic computers to activation analysis depends on sufficiently effective algorithms. An algorithm is proposed which makes allowance for certain difficulties previously encountered with other algorithms. A self-consistent algorithm is capable of avoiding interfering isotopes, the half-lives of which are very close to that of the isotope sought. (K.S.W.)

55662 NEUTRON ACTIVATION ANALYSIS. Guinn, Vincent P. (Gulf General Atomic, Inc., San Diego, Calif.). pp 447-500 of Physical Methods of Chemistry. Pt. IIID. /Weissberger, Arnold (ed.). New York; John Wiley and Sons, Inc. (1972).

A review of neutron activation analysis is presented that includes theory of neutron activation; neutron sources and types of neutron reactions; forms of the neutron activation analysis method; sensitivity of neutron activation analysis for various elements; sources of error, accuracy, and precision; and applications of neutron activation analysis in chemistry. (D.H.M.)

55663 DETERMINATION OF LOW AMOUNTS OF Ta IN Ce USING ACTIVATION ANALYSIS. Rouchaud, J. C.; Revel, Gilles (CNRS, Vitry-sur-Seine, France). Compt. Rend., Ser. C; 274: No. 25, 2063-5(19 Jun 1972). (In French).

Cerium was irradiated during 7 days in a neutron flux of 3.10^{12}n/cm^{-2}/s^{-1}. Tantalum was separated from cerium by cation exchange chromatography in tartaric medium. Tantalum radioactivity was measured by γ spectrometry. The detection limit obtained is 0.0002 μg/g. (France)

55664 DETERMINATION OF TRACE ELEMENTS IN SILICATE ROCKS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. Chowdhury, A. N.; Das, A. K. (Central Chemical Lab. Geological Survey, Calcutta). Z. Anal. Chem.; 261: No. 2, 126-7(1972).

A single sample solution prepared by decomposition of the rock samples using hydrofluoric and perchloric acids is used without any concentration by chemical methods to determine traces of Cu, Zn, Ni, Pb, Cr, Sr, and Li. The standard deviations were 2 to 3 ppM on the average and the coefficients of variation about 5 to 8 for about 10 to 300 ppM metal content. (M.C.G.)

55665 MULTIELEMENT ANALYSIS OF ALLENDE METEORITE BY NEUTRON ACTIVATION ANALYSIS AND SPARK SOURCE MASS SPECTROMETRY. Morrison, G. H.; Nadkarni, R. A.; Potter, N. M.; Rothenberg, A. M.; Wong, S. F. (Cornell Univ., Ithaca, N. Y.). Radiochem. Radioanal. Lett.; 11: No. 3-4, 251-68(15 Sep 1972).

The recently fallen meteorite Allende de Publito from Mexico was analyzed for major, minor, and trace elements. Instrumental neutron activation analysis, radiochemical neutron activation analysis, and high-resolution γ spectrometry, and spark source mass spectrometry were used to determine 57 elements. A comparison is made with other type III carbonaceous chondrites. (auth)

55666 DETERMINATION OF OXYGEN IN LITHIUM AND SODIUM BY PHOTON ACTIVATION. Chapyzhnikov, B. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow); Evzhanov, Kh. N.; Malikova, E. D.; Kunin, L. L.; Samosyuk, V. N. Radiochem. Radioanal. Lett.; 11: No. 3-4, 275-80 (15 Sep 1972).

The determination of oxygen in alkali metals is described. For rapid separation of ^{15}O, the distillation of water was employed. An oxygen content of about 2×10^{-5} wt % can be determined. A microtron was used as a γ source. (auth)

55667 DETERMINATION OF NITROGEN IN LITHIUM AND SODIUM BY PHOTON ACTIVATION. Chapyzhnikov, B. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow); Evzhanov, Kh. N.; Malikova, E. D.; Kunin, L. L.; Samosyuk, V. N. Radiochem. Radioanal. Lett.; 11: No. 3-4, 269-73(15 Sep 1972).

The determination of nitrogen in alkali metals is described. ^{13}N was separated as ammonia by distillation. A microtron was used as γ source. The sensitivity of the method is about 2×10^{-5} wt %. (auth)

55668 URANIUM ASSAY BY NONDESTRUCTIVE NEUTRON ACTIVATION ANALYSIS. Campbell, F. T.; Steele, E. L. (Louisiana State Univ., Baton Rouge). Radiochem. Radioanal. Lett.; 11: No. 3-4, 245-50(15 Sep 1972).

A fully nondestructive neutron activation analysis method for uranium assay in rocks and core samples was developed. The 1596.6-keV γ ray of ^{140}La was measured at two different decay times and simultaneous equations used to eliminate the contribution from ^{139}La(n,γ)^{140}La. The remaining activity measured is the result of the sequence: ^{235}U(n,f) $\rightarrow$ ^{140}Ba $\rightarrow$ ^{140}La and is indicative of the uranium content. No special equipment, except the Ge(Li) detector system was needed and a sensitivity of 0.5 ppM was obtained for a 14 h activation at 1.8×10^{12} ncm^{-2} sec^{-1}. (auth)

55669 DETERMINATION OF COBALT BY NEUTRON ACTIVATION AND SUBSTOICHIOMETRIC EXTRACTION WITH 2-NITROSO-1-NAPHTHOL. Nadkarni, R. A.; Haldar, B. C. (Inst. of Science, Bombay). Radiochem. Radioanal. Lett.; 11: No. 3-4, 237-44(15 Sep 1972).

2-Nitroso-1-naphthol (2N1N) was used for the substoichiometric extraction of cobalt from thermal neutron irradiated biological materials. In the presence of citrate and H_2O_2, 2N1N is a selective reagent for cobalt, which is extracted into chloroform in the pH range 2.5 to 5. The Co : 2N1N complex is 1 : 3 in composition. The method is used for the determination of trace amounts of cobalt in Bowen's kale, University of Kentucky 1R1 tobacco, and human blood serum. (auth)

55670 PRACTICAL BIBLIOGRAPHY ON ACTIVATION ANALYSIS. Junod, E. (CEN, Grenoble, France). Radiochem. Radioanal. Lett.; 11: No. 3-4, 219-27(15 Sep 1972). (In French).

A bibliographic file was created on a computer disk memory for the practical need of an activation analysis laboratory. It contains only selective references among whole publications on the subject. References are coded by four types of keywords: matrix elements, analyzed elements, authors and a group of keywords explaining more about the method. A program can make selective sorting by combinations of the codes. (auth)

55671 INVESTIGATION OF GAMMA EMITTERS OF UNKNOWN SPECTRA. Junod, E. (CEN, Grenoble, France). Radiochem. Radioanal. Lett.; 11: No. 3-4, 207-17(15 Sep 1972). (In French).

A computer code for searching possible attributions of measured γ rays to radioisotopes is described. Using an original table of nuclear reactions and corresponding γ energies, the program is specially suited to neutron activation analysis. (auth)

55672 THAPA, THEORETICAL ACTIVATION ANALYSIS PROGRAM. Junod, E. (CEN, Grenoble, France). Radiochem. Radioanal. Lett.; 11: No. 3-4, 199-206(15 Sep 1972). (In French).

It may be interesting to study theoretically the possibilities of activation analysis by exploring different irradiation techniques and variable irradiation and decay times. The program, based on a nuclear reaction file, computes the activities of radioisotopes and their ratios and gives a simulated spectrum for each predetermined condition. (auth)

55673 RAPID ACTIVATION ANALYSIS OF HIGH-PURITY ZIRCONIUM OXIDE FOR HAFNIUM WITH CORRECTION FOR THE INTERFERING ACTIVITY OF ^{19}O. Okada, M.; Yonezawa, C.; Tamura, N. (Japan Atomic Energy Research Inst., Tokai). Radiochem. Radioanal. Lett.; 11: No. 3-4, 193-7(15 Sep 1972).

A rapid method was developed for determination of trace amounts of hafnium in zirconium oxide. A short irradiation period was used to reduce an interfering γ ray from 29-sec ^{19}O. Counting is performed so as to obtain several γ spectra in successive time intervals. The size of the resultant 215-keV photopeak was corrected for the contribution of ^{19}O. This contribution was equal to that of about 0.05 ppM hafnium under the given conditions. (auth)

55674 DETERMINATION OF B AND Li CONTENT BY MEANS OF (n,α) REACTION. Bischof, Jan; Dlouhy, Zdenek; Kvitek, Jiri; Kvitek, Vaclav; Vobecky, Miloslav (Nuclear Research Inst., Rez. Czech.). Jad. Energ.; 18: No.9, 296-8(Sep 1972). (In Czech).

The methods and experimental facility primarily designed for investigation of low-cross-section (n, α) reactions with thermal neutrons were applied for determination of boron and or lithium in various materials. Admixtures as small as 10^{-8} to 10^{-9} g/cm^2 can be detected. (auth)

55675 RAPID METHOD FOR DETERMINING THE ABSOLUTE OXYGEN CONTENT IN IRON POWDER. Adamek, A.; Severa, F. (Inst. of Physics, Bratislava). Fyz. Cas.; 21: No. 4, 215-20 (1971).

The ^{16}O(n,p)^{16}N reaction with 14-MeV neutrons was used for determining the absolute oxygen content. The results of the analyses of 40 iron powder samples are presented. Only 2 to 3 min were needed to analyze a sample. (NSA of Czech)

55676 SIMULTANEOUS DETERMINATION OF NINE ELEMENTS IN SOME TISSUES OF THE RAT USING NEUTRON ACTIVATION ANALYSIS. Kollmer, W. E.; Schramel, P.; Samsahl, K. (Gesellschaft fuer Strahlen- und Umweltforschung mbH., Neuherberg, Ger.). Phys. Med. Biol.; 17: No. 4, 555-62(Jul 1972).

The concentrations of nine inorganic elements were determined in dry samples of brain, liver, spleen, uterus, ovary, and faeces of adult laboratory rats, using a method which combined chemical separation and determination by neutron activation analysis. Peculiar patterns of distribution were found for Na, Ca, Fe, Zn, Cu, Mo, Co, and Rb. Maximum concentrations of Zn, Cu, Mo, Co, and Rb were regularly found in liver tissue. W concentrations in the different tissues were not significantly different from one another and showed wide variations between samples of the same tissue derived from different animals. (auth)

55677 DETERMINATION OF URANIUM, THORIUM, AND SCANDIUM IN BAUXITE AND RED MUD BY NEUTRON ACTIVATION ANALYSIS. Miskei, Mihaly; Bujdoso, Erno. Femip. Kut. Intez. Kozlem.; 10: 229-35(1971). (In Hungarian).

Traces of U, Th, and Sc were determined in bauxite and red mud samples by neutron activation. Samples were digested before radiation. Ion exchange chromatography was applied for the separation of the trace elements. It was stated that Th and Sc get into the red mud, while a part of uranium dissolves in the aluminate liquor in the course of the Bayer-process. (auth)

55678 NONDESTRUCTIVE ACTIVATION ANALYSIS OF IRON AND STEEL WITH 14 MeV NEUTRONS. van Grieken, R. Ghent; Ghent Rijksuniversiteit (1971). 173p. (In Dutch).

Thesis.

Some fundamental aspects of 14 MeV neutron activation analysis were studied. The topography of the neutron emission is an essential factor in the planning and optimalization of the analysis methods. Consequently, the neutron flux distribution was extensively measured, axially as well as radially, with respect to targets of different diameters. The well-known determination of oxygen in steel was further extended with a statistical study of expected and experimentally achieved precision, as well as of the instrumental errors that occur with oxygen determinations. 14-MeV neutron activation analysis was also applied to the determination of silicon. Particular attention was paid to the determination of silicon in magnetic steel sheet containing ca 3% Si. In these silicon determinations, the most important interference arose from phosphorus, which by $^{31}P(n,\alpha)^{28}Al$ yields the same isotope as silicon, with ca twice smaller yield. From the same set of measurements, the copper content of steels and cast irons could be derived directly. (auth) (Belgium)

55679 NON-DESTRUCTIVE NEUTRON ACTIVATION ANALYSIS FOR THE DETERMINATION OF MANGANESE AND ZINC IN HUMAN SKIN BIOPSIES. Gooden, D. S. (St. Francis Hospital, Tulsa, Okla.). Phys. Med. Biol.; 17: No. 1, 26-31(Jan 1972).

Nondestructive neutron activation analysis was used to determine Mn and Zn concentrations in biopsy-sized human skin samples. This procedure varies from most conventional neutron activation techniques in that no chemical separations are used. Seventeen samples of skin taken from the scapular region of normal subjects, four samples from patients with lupus erythematosus, one of basal cell carcinoma, one psoriatic erythroderm biopsy and one scleroderma biopsy were studied. In this limited series, patients with scleroderma, basal cell carcinoma, and psoriasis erythroderma all manifested Zn concentrations lower than any of the normals. The Mn results in Lupus erythematosus were less impressive, but possibly suggested a level higher than in most normals. (auth)

55680 NEUTRON-CAPTURE GAMMA-RAY STUDIES OF MARINE MANGANESE NODULES USING A NUCLEAR REACTOR AND A ^{252}Cf SOURCE. **Wiggins, Peter F. (Naval Academy, Annapolis, Md.); Duffey, Dick; El Kady, A. A. Anal. Chim. Acta; 61: No. 3, 421-30(Oct 1972).**

The analysis of manganese nodules formed on the ocean floor is considered. Neutrons from the thermal column of a 10-kW pool-type research reactor and a 120-μg californium-252 source were used to study the prompt photon emissions from neutron capture in these nodules. Despite the complex spectra obtained by irradiation of seawater, it is possible to detect and estimate manganese in nodules by means of the peaks at 7.06, 6.55, 6.22, and 6.04 MeV. A possible in situ experimental arrangement is discussed. (auth)

55681 INVESTIGATION OF PURIFICATION METHODS FOR SEMICONDUCTOR MATERIALS. **Schmied, H.; Ziffermayer, G. (Brown, Boveri and Co. Ltd., Baden, Switzerland). Sprechsaal Keram. Glas Email Silikate; 104: No. 24, 1102-4(1971). (In German).**

The influence of slightest impurities on the operation of Si electronic components is briefly described. Tests are discussed in detail that were performed in order to evaluate various semiconductor purification methods (e.g. zone melting). The microanalysis of surface impurities was made using neutron activation analysis and autoradiography. (GF)

55682 NEUTRON ACTIVATION ANALYSIS PROCEDURE FOR THE DETERMINATION OF MERCURY IN SOIL AND ROCK SAMPLES. **Aruscavage, Philip J. (Geological Survey, Denver, Colo.). U. S., Geol. Surv., Prof. Pap.; No. 800-C, 209-14(1972).**

A radiochemical procedure was developed for the determination of mercury in soil and rock samples. After irradiation in a thermal neutron flux of 2×10^{12} n/cm^2 sec^{-1} for 4 to 16 hours, the sample is decomposed by fusion with Na_2O_2 in the presence of carrier mercury. A distillation of elemental mercury and a precipitation as mercury (II) sulfide leaves mercury in a radiochemically pure form suitable for counting. The chemical yield is determined by reirradiation. Mercury was determined in a series of samples, first by instrumental neutron activation analysis and then by the radiochemical procedure, to verify that the radioactive mercury in the sample equilibrates with the carrier mercury before fractionation can occur. The coefficient of variation for replicate determinations on the U. S. Geological Survey standard rock W-1 (0.12 ppM) was 7.9% and for the Colorado School of Mines mercury standard No. 3 (12 ppM) was 3.6%. The results for mercury in the eight U. S. Geological Survey standard rocks and the Colorado School of Mines mercury standard compared favorably with literature values. The three-sigma detection limit for a 16 hour irradiation in a thermal neutron flux of 2×10^{12} n/cm^2 sec^{-1} is 0.3 ppB. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 55925 and 56117.

55683 (AEEW-R-795) DETERMINATION OF TRACE METAL IMPURITIES IN REACTOR COOLING WATER CIRCUITS USING ION EXCHANGE MEMBRANES. James, H. (Atomic Energy Establishment, Winfrith (England)). Mar 1972. 28p. Dep. NTIS (U. S. Sales Only).

The use of ion exchange resin-impregnated membranes for the determination of trace metals in water is described. Parts per billion (microgram per litre) levels of cationic impurities are concentrated on ion exchange membranes from large volume samples of reactor cooling waters. The collected metals are removed from the membranes by acid digestion and determined by atomic absorption measurements. Gamma spectrometry measurements of activated cations were used to assess the efficiency of membrane collection, and collate specific activity data of some long-lived nuclides. The method enables determination, for example, of cobalt down to 0.01 μg Co per litre to an analytical precision of ±12% relative, with a negative bias of 15% relative, obtained on a 250 litre sample. At a cobalt level of 0.1 μg Co per litre, the negative bias is less than 1% relative on a 60 litre sample volume. Chromium, copper, iron, nickel, and zinc were also determined. (auth)

55684 (BARC-617) DETERMINATION OF TRACES OF THORIUM IN PURE URANIUM. Thakur, N. V.; Gokhale, R. V.; Mahajan, L. M.; Jogdeo, S. M. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 10p. Dep. NTIS (U. S. Sales Only).

A method is described for the separation and spectrophotometric determination of thorium in pure uranium samples. Uranium is extracted in 35% TBP-kerosene mixture from a solution of 6M HCl. Thorium remains in the aqueous phase. It is then separated from other impurities by precipitation with oxalic acid, using lanthanum as a carrier. The oxalate is ignited and thorium determined spectrophotometrically with thoron. Thorium down to 1 ppM in nuclear pure uranium samples can be determined by this method. (auth)

55685 (BNWL-B-196) ANALYSIS OF THORIUM-URANIUM CARBIDE COATED FUEL BEADS. Robertson, D. M. (Battelle Pacific Northwest Labs., Richland, Wash.). 12 Jul 1972. Contract AT(45-1)-1830. 27p. Dep. NTIS.

Thorium carbide—uranium carbide fuel spheres are coated with pyrolytic carbon and silicon carbide (SiC) for fuel containment purposes. Most methods of fuel assay involved grinding the beads followed by acid dissolution of fuel and leaching of the residue. Gas ignition (volatilization) of the coating material followed by acid dissolution was studied. This process converts a five-gram bead sample to a clear solution (no residue) in less than 1 hour. Subsequent ^{235}U assays agreed well with other methods. (auth)

55686 (CEA-N-1551) SPECTROPHOTOMETRIC DETERMINATION OF Pu. APPLICATION TO THE DETERMINATION OF TRACES OF Pu IN U WITHOUT SEPARATION. Hucleux, Monette; Cauchetier, Philippe (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Aug 1972. 31p. (In French). Dep. NTIS (U. S. Sales Only).

A method of determining Pu in various compounds, in particular U, without separation, is described. The method is based upon the characteristics of the 831 nm absorption peak of Pu(VI): this peak is specific and at its maximum corresponds to a relatively high molar extinction coefficient ($\epsilon = 405$ in a 4M nitric medium). The Pu was oxidized by Ag(II) oxide, the excess being destroyed when hot. The determination was effected by measuring the height of the peak obtained by scanning the spectrum between 800 and 860 nm. The nitrate ion concentration was easily regulated using a 4M nitric acid solution as the medium. The operating conditions, and in particular, the spectrophotometer adjustments are discussed. The standard deviations obtained were 0.5 mg l^{-1} for a concentration between 5 and 55 mg l^{-1}, and 2 mg l^{-1} for a concentration between 50 and 550 mg l^{-1}. It is possible to detect concentrations down to 5 ppM of Pu in U. (auth)

55687 (COO-1147-44) PHYSICAL CHEMISTRY OF HIGHLY ENERGETIC SYSTEMS. **Final Technical Report, February 1962–May 1972. Stafford, F. E. (Northwestern Univ., Evanston, Ill. Dept. of Chemistry). 15 Jul 1972. Contract AT(11-1)-1147. 12p. Dep. NTIS.**

Work for the ten year period, 1962-72 is summarized under the headings: Boranes and Other Hydrides; Ionization Cross Sections and Fragmentation; Oxohalides; Instrumentation; Miscellaneous. Ionization and fragmentation processes in high-temperature mass spectrometry were studied. (29 references) (auth)

55688 (K-L-6300) ON-STREAM MONITORING OF URANIUM ISOTOPES. Jones, H. C. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 29 Sep 1972. Contract W-7405-eng-26. 8p. Dep. NTIS.

The need for improvement in automatic monitoring of uranium isotopes in process UF_6 gas streams led to the development of two types of special purpose mass spectrometers and experimental evaluation of a third type. A 6-in. radius Nier-type mass spectrometer has been monitoring product at withdrawal points for more than 2 years with an on-stream efficiency of better than 98%. This instrument records a weight percent ^{235}U measurement every 50 seconds. Measurements are made on an absolute basis; a standard is introduced only when it is necessary to check instrument performance. The solid-state design of the electronic circuitry is largely responsible for the reliability achieved. A 5-inch-radius, Dempster-type mass spectrometer is being redesigned to improve both the reliability and precision of on-stream isotopic analyses at natural feed and depleted locations in the gaseous diffusion cascade. A weight percent ^{235}U measurement will be made every 5 minutes on a relative basis, referring to a standard with a known $^{235}U/^{238}U$ ratio. This instrument also will employ extensive solid-state circuitry. A quadrupole mass spectrometer is being investigated as a more flexible instrument for stream monitoring, as contrasted with the above types that make analyses at frequent intervals. Absolute measurements by the quadrupole instrument will be rapid enough to give essentially a continuous indication of wt% ^{235}U. Each of the three spectrometers described uses a small (~0.040 inch ID) nozzle for introduction of the gaseous UF_6 into an open type ionization chamber for low memory and quick recovery from shifting ^{235}U concentrations. (auth)

55689 MAXIMIZATION OF SENSITIVITIES IN TANTALUM RIBBON FLAMELESS ATOMIC ABSORPTION SPECTROMETRY. Hwang, Jae Y.; Mokeler, Chrles J.; Ullucci, Paul A. (Instrumentation Lab., Inc., Lexington, Mass.). Anal. Chem.; 44: No. 12, 2018-21(Oct 1972).

A flameless atomic absorption technique based on an enclosed atomization chamber with a tantalum ribbon as a heating element is critically evaluated with respect to maximizing sensitivity. Parameters involved in the study are temperature and height of measurements, chemical-thermal properties, and flow rates of the purge gases. Thirty-seven elements are presented with sensitivities and detection limits that range from 10^{-8} to 10^{-13} gram. Included are Cs, Eu, Sr, and Te. (auth)

55690 PRODUCTION AND ANALYSIS OF SPECIAL HIGH-PURITY ACIDS PURIFIED BY SUB-BOILING DISTILLATION. Kuehner, Edwin C.; Alvarez, Robert; Paulsen, Paul J.; Murphy, Thomas J. (National Bureau of Standards, Washington, D. C.). Anal. Chem.; 44: No. 12, 2050-6(Oct 1972).

Sub-boiling distillation from pure quartz or Teflon (DuPont) stills was investigated for the production of high-purity inorganic acids and water. Nitric, hydrochloric, hydrofluoric, perchloric, and sulfuric acids produced by this method contained significantly lower cationic impurities than high-purity acids from commercial sources. A complete system, including the Class 100 environment, production, and storage of these high-purity reagents is described. A method based on spark source mass spectrographic isotope dilution analysis was developed for the simultaneous determination of 17 elements in these materials. Results of the analyses of both the acids purified by sub-boiling distillation and the ACS reagent grade acids used as starting materials are reported. The sum of the common impurity elements determined in the purified acids ranged from 2.3 ppB in nitric acid to 27 ppB in sulfuric acid. No element in any of the purified acids exceeded 10 ppB and most were well below the 1-ppB level. (auth)

55691 USE OF THE MICROWAVE-EXCITED EMISSIVE DETECTOR FOR GAS CHROMATOGRAPHY FOR QUANTITATIVE MEASUREMENT OF INTER-ELEMENT RATIOS. Dagnall, R. M.; West, T. S.; Whitehead, Paul (Imperial Coll. of Science and Tech., London). Anal. Chem.; 44: No. 12, 2074-8(Oct 1972).

An attempt was made to measure the ratio of chlorine, iodine, bromine, sulfur, and phosphorus emission to carbon emission for a range of simple compounds, to measure the factors which affect these ratios, and to determine the potential of this technique for the determination of inter-element ratios. Results indicate that for the limited range of sulfur, iodine, and phosphorus compounds investigated, the use of the simple expedient of simultaneously monitoring emission from two atomic lines can be used to determine the quantitative relationship between the heteroatoms and the number of carbon atoms in the compound. In each instance the measured ratio was found to be independent of carrier gas flow rate and concentration. Hence, when these atomic emissions are used, it is unnecessary to know the exact concentration of a compound under examination and it is not essential to obtain a good peak shape in order to determine the inter-element ratios. The results obtained for chlorine- and bromine-containing compounds can be satisfactorily explained on the basis that the emitting species are diatomic (Cl_2 and Br_2). The ratios of chlorine or bromine emission to atomic carbon emission were both carrier gas flow rate and concentration dependent. A series of peak ratios for a range of concentrations of the sample under investigation would be required together with a standard sample in a similar range for analytical purposes. (auth)

55692 SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(IV) WITH POTASSIUM IRON(III) CYANIDE. Gayer, K. H.; Lifshitz, H. T. (Wayne State Univ., Detroit). Anal. Chem.; 44: No. 12, 2104-7(Oct 1972).

Aqueous U(IV) solutions are reacted with ferric ion ($FeCl_3$) in acid medium: $U^{4+} + 2Fe^{3+} + 2H_2O \rightarrow UO_2^{2+} + 2Fe^{2+} + 4H^+$. The resultant ferrous ion is then reacted with potassium ferricyanide to produce a dark blue complex, which has the characteristics of a bluish solution, and is subject to reproducible spectrophotometric absorption of visible light. The effects of certain organic compounds, pH, and various inorganic compounds were studied. (J.G.B.)

55693 OXYGEN/METAL RATIOS IN PLUTONIUM/URANIUM OXIDE FUELS. A STUDY OF GRAVIMETRIC METHODS. McGowan, I. R.; Johnson, C. R.; Swinburn, K. A. (British Nuclear Fuels Ltd., Cumberland, Eng.). pp 3-21 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Gravimetric methods for determination of oxygen/metal (O/M) ratio in sintered and unsintered plutonium/uranium oxides require conditions to be established so that (a) the sample is converted by an appropriate thermal treatment to a stoichiometric reference state, and (b) the weight change resulting from the conversion is caused by change in oxygen content of the sample. Studies on unsintered plutonium oxide powder prepared via the oxalate route show that a stoichiometric dioxide reference state is attainable, but that the weight change caused by the conversion is due primarily to the loss of surface adsorbed water and carbon dioxide. The oxide shows apparent O/Pu ratios between 2.00 and about 2.3 depending on the history of the material and its pretreatment. Sorbed impurities are also important in unsintered plutonium/uranium oxide powders. With the sintered oxides, sorbed impurities are normally present in such small amounts that their effect is insignificant. The reference state is generally MO_2, though U_3O_8 is sometimes used for uranium oxide. Evidence is presented that stoichiometric U_3O_8 can consistently be produced by controlled heating in air, and also that it is possible to determine the O/M ratio of sintered mixed oxide by oxidation to M_3O_8 provided the plutonium oxide content is less than 10%. At higher plutonium concentrations, the oxidized state is variable in composition, and MO_2 is a satisfactory reference state. Ways of forming stoichiometric MO_2 by oxidation/reduction cycles and by equilibration in a gas of the appropriate oxygen potential are compared. The effect of nonvolatile impurities is discussed. Procedures are given for the determination of O/M ratio in sintered fuels showing a standard deviation of ±0.001, and which are suitable for the analysis of several samples concurrently. The methods provide a reliable, economical analysis in support of the manufacture of sintered oxide fuels. (auth)

55694 COMPARISON OF TWO METHODS OF DETERMINING THE OXYGEN-TO-METAL RATIO IN MIXED PLUTONIUM—URANIUM OXIDES. Ganivet, M.; Benhamou, A. (CEN, Cadarache, France). pp 23-33 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

The oxygen-to-metal ratio in mixed plutonium—uranium oxides can be determined by several methods: oxygen analysis, thermogravimetry in a controlled atmosphere, and x-ray diffraction measurement of the reticular parameter. The results obtained using the first two methods were compared. It is found that agreement is better than 0.3% and can even attain 0.1%. (auth)

55695 REVIEW AND COMPARISON OF METHODS FOR THE DETERMINATION OF OXYGEN/URANIUM RATIOS IN URANIUM

OXIDES. Florence, T. M. (Australian Atomic Energy Commission, Lucas Heights). pp 45-56 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

The various techniques available for determination of O/U ratios in hyperstoichiometric and hypostoichiometric uranium dioxide are compared and discussed. Included in the discussion are nondestructive methods based on x-ray diffraction and emf measurements of high temperature cells such as Ni, NiO/ZrO_2 CaO/UO_{2+X}. Other dry-way methods involving inert gas fusion, reduction of UO_{2+X} with hydrogen or carbon monoxide, reaction with bromine trifluoride, oxidation to U_3O_8, and thermogravimetric analysis techniques are critically reviewed. Wet chemical methods for measurement of U/O ratios in hyperstoichiometric UO_2 all rely on determination of the uranium(VI) associated with excess oxygen. Titrimetric, polarographic, and controlled potential and constant-current coulometric methods for the determination of uranium(VI) and total uranium are discussed. Techniques available for the wet chemical analysis of hypostoichiometric UO_2 are also included in the discussion. Precision, accuracy, and applicability of the various techniques are tabulated, and recommendations are made for the most suitable methods for the determination of O/U ratios in UO_{2+X} containing different levels of excess oxygen. (auth)

55696 SAMPLING AND ANALYSIS IN THE PLUTONIUM AND URANIUM MIXED OXIDE FABRICATION PROCESS. Watanabe, S.; Nakano, H.; Onishi, K.; Tabata, Y. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan). pp 67-75 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Since January 1966, 1000 kg plutonium and uranium mixed oxide have been fabricated by the PNC Plutonium Laboratory. Analysis and assay were carried out for quality control and guarantee of these products and input materials. The sampling points in the mixed oxide fabrication process and the appropriate number of samples for analysis are discussed. The process consists of powder blending, cold pressing, sintering, centerless grinding, and vacuum drying. The sample for determination of plutonium and uranium is usually taken from the manufactured pellet. It is, however, proved that in practice the contents of plutonium and uranium can be guaranteed by the analysis of a mixed powder sample taken from the blending process. For determination of metallic impurities, the sample is taken from the centerless ground pellet, and for that of the nonmetallic impurities from the final pellet. Experiments showed that the variance with analysis of plutonium in plutonium solution is almost the same as that with analysis of plutonium in the mixed oxide pellet. The coefficient of variation of both analytical results is about 1%. Appropriate numbers of samples for analysis and assay in the plutonium and uranium mixed oxide pellet fabrication process were calculated statistically. (auth)

55697 INVESTIGATION AND PREPARATION OF REFERENCE SPECIMENS FOR DETERMINING IMPURITIES AND PLUTONIUM IN METALLIC PLUTONIUM. Buffereau, M. (CEA, Bruyeres-le-Chatel, France); Vienney, J.; De La Graviere, M.; Pichotin, B. pp 77-99 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Reference specimens are necessary for the routine checking of analytical methods. Two different approaches were considered. The first involves determining total plutonium in a metallic specimen. An original method of preparation was developed, in which the metal is split into small pieces of 500 mg to 1 g without becoming polluted. Great attention was paid to the inspection of these standards. The weighing operation, which can introduce a considerable error, was the subject of a detailed study leading to the development of a special installation. The precautions observed for the glovebox atmosphere served to limit oxygen contamination. The second method concerns the problem of impurities. It was shown that a metal taken from production is unsuitable, even after homogenization, because most of the elements contained in it are not present in significant concentrations. Therefore, metallic impurities were added deliberately to an electrolytically refined metal. After homogenization at 900°C for several hours in a sealed tantalum container, the metal was cut up in a way facilitating statistical study of the analytical results and keeping the plutonium consumption to a relatively low value. Several methods were developed in two laboratories for studying the impurity distribution and establishing the most probable concentrations. An initial series of CEA interlaboratory analyses confirmed the usefulness of such specimens. The experiment has proved sufficiently conclusive for the preparation of three specimens to be undertaken. The physico-chemical methods of analysis have indicated the percentage of plutonium in these specimens with great accuracy. (auth)

55698 PRODUCTION AT CEA OF REFERENCE SPECIMENS FOR DETERMINING IMPURITIES IN PLUTONIUM. Ganivet, M.; Genty, C.; Huart, A.; Pichotin, B. (CEN, Cadarache, France). pp 101-13 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

The determination of impurities in plutonium or plutonium oxide usually involves relative methods calling for prior calibration with reference specimens. The CEA Analytical Methods Committee recommended a common program. A range of six plutonium oxide reference specimens containing known amounts of impurities was prepared by mixing a powder, composed of the impurities in the form of stable compounds, with the plutonium oxide. This procedure was preferred to the impregnation procedure, which involves adding the impurities in solution to the plutonium oxide and calcining the whole. The advantages and disadvantages of the two methods are analyzed. The oxide used was produced by calcining chips machined from an ingot of electrolytically refined plutonium. Great precautions were taken to avoid pollution during preparation and to ensure perfect homogenization of the various mixtures. Tests performed by several laboratories made it possible to determine the purity of the matrix and to verify the range of impurity concentrations in the five mixtures. The most probable concentrations were determined for 16 different elements. (auth)

55699 MANUFACTURE OF URANIUM CHECK SPECIMENS FOR SPECTROGRAPHIC ANALYSIS. Neuilly, Michele (CEN, Cadarache, France). pp 115-35 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

The conditions under which 12 uranium billets were prepared as reference materials for spectrographic analysis are described. The impurities were added in two different ways; some were present in the basic uranium and the others were added in elemental form to the uranium during casting. The results of impurity determinations performed by several laboratories using different methods are presented, and also the probable concentrations. Specimens of these billets are currently available for any laboratories which may be interested. (auth)

55700 PROPER USE OF REFERENCE MATERIALS FOR THE ACCURATE DETERMINATION OF URANIUM, PLUTONIUM, AND THORIUM IN THE NUCLEAR FUEL CYCLE. Lauer, K. F.; Le Duigou, Y. (EURATOM, Geel, Belg.). pp 145-52 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

The problem of using reference materials for the calibration of many different analytical methods, which in turn have to be applied to a wide variety of nuclear materials, is considered. An everpresent difficulty is the possible existence of systematic differences between this scheme of calibration and the actual analysis of the unknown materials. The available standard reference materials (SRM) are of such purity and composition that they are often not comparable with some of the differently composed and more impure technical materials that have to be analyzed. This difference might be of more or less importance depending on the type of analytical methods used. Some typical cases where possible systematic deviations were found are cited. The available certified reference materials and their potential usefulness for various analytical methods are discussed. (auth)

55701 ANALYSIS OF UNIRRADIATED URANIUM OXIDE NUCLEAR FUEL. Tolk, A.; van Raaphorst, J. G. (Reactor Centrum Nederland, Petten). pp 175-85 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

For determination of total U and impurities in UO_2 for quality control, standardized analytical procedures are generally accepted. The following modifications were developed: (1) determination of total U by dissolution of the sample in H_3PO_4, quantitative oxidation of the uranium to U(VI), and reductometric titration of U(VI) with Fe(II); (2) determination of x in UO_{2+x} by dissolution in H_3PO_4 and reductometric titration of U(VI) with Fe(II); (3) determination of Cl and F with an improved pyrohydrolytic procedure; (4) analysis of C after conversion into CO_2 by titration in nonaqueous medium; (5) analysis of included permanent gases in UO_2 by vacuum extraction and gas chromatographic determination; (6) modified Scribner—Mullin procedure on sample aliquots in briquetted form for the determination of metallic impurities; (7) determination of rare earth impurities in UO_2 after isolation from U and concentration by absorption from fluoride solution on a cation exchange resin and emission spectrographic analysis. These analytical methods are discussed in detail and relevant experimental results are given. (auth)

55702 PRECISE DETERMINATION OF URANIUM. Cattin, G.; Hugon, J. (CEA, Pierrelatte, France). pp 217-25 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

The development of a method of liquid-phase chromatography in columns of Kel'f impregnated with tributyl phosphate is described. Excellent results were obtained: separation efficiencies of more than 99.99% made it necessary to re-examine and improve the standard redox titration. Under these conditions the reproducibility is ±0.04% for a single determination. For a series of four tests the standard deviation is 0.0138 and the accuracy approximately 0.03%, taking into account the calibration that is done with metallic uranium having a total impurity concentration of less than 50 ppM. For the latter operation tests are in progress aimed at using iron with an even better known degree of purity (99.999%). (auth)

55703 PROBLEMS ENCOUNTERED IN HIGH ACCURACY ANALYSIS OF PLUTONIUM. Boden, R. M.; Demildt, A. C. (SCK/CEN, Mol, Belg.). pp 227-35 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Analysis of plutonium by different electrochemical methods is considered. Most of the determinations are based on potentiometric, amperometric, or coulometric methods. An attempt was made to detect the causes of the systematic differences between the titration results and the real values. Special attention was paid to the impurities in the plutonium solutions and to the errors introduced by each step of the titration or batch titration procedures. (auth)

55704 ANALYSIS OF NUCLEAR FUEL MATERIALS AT AERE. Taylor, B. L.; Phillips, G.; Milner, G. W. C. (Atomic Energy Research Establishment, Harwell, Eng.). pp 237-52 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Some recent advances in the analysis of oxide, carbide, and nitride nuclear fuel materials at AERE are described. The methods were all used on plutonium-containing material generally under glovebox conditions. Two important measurements in this field are the oxygen/metal and plutonium/uranium ratios. A method based on equilibration with CO/CO_2 mixtures was developed for determining the O/M ratio in UO_2 and UO_2/PuO_2 material. Both hypo- and hyper-stoichiometric oxides can be analyzed and the standard deviation for the O/M ratio is 0.0005. Additional information on the carbon and nitrogen content can be obtained from the same sample. The uranium/plutonium ratio is determined by a coulometric method. The uranium and plutonium are measured separately on different aliquots of the sample solution using an automatic coulometer. Where less precise information on the oxygen content of oxides is required, an inert gas fusion method was developed. The same equipment can be used for determining nitrogen in nitrides and oxygen and nitrogen at impurity levels in carbides. A graphite resistance furnace capable of temperatures ≤2600°C is used for the gas release. Large amounts of gas are measured manometrically, but gas chromatography is preferred for impurity level determinations. Two improved methods were developed for measurement of metallic impurities. The specification for fast reactor materials places limits on the Fe, Cr, Ni, and W concentrations. An x-ray spectrometry method was used to determine these elements. Samples were prepared by fusion of the oxides with borax. The correct choice of background position is essential to the accuracy of the method. In emission spectrographic analysis, the carrier distillation method was modified so that sample weights of 1 mg can be used, which is 1/100 of the normal amount. This is an advantage when limited sample is available for analysis or when irradiated material is to be analyzed. Other advantages are the easier preparation of the electrode charge and the fact that matrix effects are reduced because of the higher proportion of buffer. (auth)

55705 APPLICATION OF ANALYTICAL METHODS IN THE CONTROL AND EVALUATION OF FUEL MATERIALS FOR THE DRAGON REACTOR EXPERIMENT. Smith, D. L. G.; Siddall, R. E.; Chapman, H. (Atomic Energy Establishment, Winfrith, Eng.). pp 253-68 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

The continued development of coated particle fuels for the Dragon Project, the OECD High Temperature Gas Cooled Reactor Experiment, required the application of a variety of analytical methods for control and evaluation of fuel materials prior to irradiation. Typically, the fission product-retaining coated particle fuel consists of uranium dioxide or uranium dioxide/thorium dioxide microspheres coated with layers of pyrolytically deposited carbon and an interlayer of silicon carbide. These coated particles are dispersed within a graphite matrix to form bodies that are subsequently assembled into prismatic fuel elements. Certain of these methods are summarized, and the difficulties associated with chemical analysis of coated—particle fuel containing an inert silicon carbide layer are discussed; procedures used for determination of uranium, thorium, and carbon are outlined. Impurities in fuel compacts are measured using spectrographic techniques including atomic absorption methods and typical limits of detection are presented; the hydrogen content of fuel compacts is one of the most important impurity measurements made and the technique used for this determination is briefly described. Uranium in cracked or broken particles is a potential source of fission products and it is therefore necessary to know the fraction of "free" to total uranium in the fuel element, which shall not exceed 1×10^{-4}. For this measurement, fuel compacts are deconsolidated to separate coated particles from the matrix graphite; uranium in cracked or broken particles is dissolved by leaching with acid or by volatilization in chlorine gas at 1000°C. Uranium is subsequently determined by fluorimetry, colorimetry, or titration depending on the level of coated particle breakage; the advantages and limitations of the methods used for free uranium measurements are discussed and typical results obtained on various types of fuel compacts are presented. Progress made in the development of a nondestructive technique for the 100% testing of fuel compacts for cracked or broken particles is described. (auth)

55706 ANALYTICAL CHEMISTRY METHODS AND EXPERIENCE AT THE HANFORD ENGINEERING DEVELOPMENT LABORATORY. Alkire, G. J.; Anderson, H. J.; Delvin, W. L.; (and others) (Hanford Engineering Development Lab., Richland, Wash.). pp 295-313 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Analytical chemistry methods and operational procedures are presented for analysis and characterization of materials in mixed uranium and plutonium oxide fuel pellets for FFTF/LMFBR (fast breeder reactor) programs. The nominal fuel compositions are 22 and 26 wt% total PuO_2 (with 12% ^{240}Pu/total Pu) and natural uranium (UO_2), with an oxygen to metal ratio of 1.97 ± 0.02. Compositional analyses include uranium and plutonium assays, uranium and plutonium isotopic composition, and oxygen to metal (Pu + U) ratios. Analyses for fuel specification impurities include methods for chloride, fluoride, moisture, gas content, nitrogen, americium-241, sulfur, and miscellaneous impurities by emission spectroscopy and spark source mass spectrometry. Physical measurements include pellet density, surface area, particle size distribution, and void size distribution. Analysis of irradiated fuels also includes measurement of fuel burnup and other analyses as required. Experience with implementation of the methods used at HEDL to make these determinations are outlined with emphasis on recent improvements, limitations, and need for new and improved methods. Specific examples of some of these methods are presented in more detail. The need for adequate chemical and isotopic standards is discussed and an example of the preparation of two plutonium isotopic standards is presented. Closely associated with standards is the need for quality control and assurance. HEDL's analytical chemistry quality control and assurance program is outlined and operating experiences are summarized. A brief description of specialized facilities and equipment used in the analyses of fuel materials is also presented. Specialized equipment, such as the spark source mass spectrometer for analyses of impurities in plutonium and the shielded electron microprobe, is described in some detail. (auth)

55707 SPARK-SOURCE MASS SPECTROMETRIC ANALYSIS OF TRACE ELEMENTS IN URANIUM HEXAFLUORIDE. Journoux, J. P.; Teulieres, P.; Boyer, R. (CEA, Pierrelatte, France). pp 315-28 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB-291; CONF-711107.

The elements present as traces in UF$_6$ can be determined by a spark-source mass spectrometric technique, which has the following advantages: it enables the impurities contained in the sample to be determined fully in a single operation; it has a sensitivity level (0.01 ppM), which cannot generally be attained by other techniques; and contamination risks are reduced to a minimum. Analyses can now be performed at the rate of one sample a day by this technique. (auth)

55708 DETERMINATION OF NEPTUNIUM: APPLICATION TO CHEMICAL REPROCESSING SOLUTIONS. Cauchetier, P.; Guichard, C.; Hucleux, Mouette (CEN, Fontenay-aux-Roses, France). pp 433-45 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB-291; CONF-711107.

In irradiated-fuel reprocessing solutions, neptunium is present at concentrations lower than 1 g/liter and is found in association with numerous other elements, especially plutonium and uranium. Two methods of determining neptunium in these solutions are suggested. One is based on the characteristic optical absorption of Np(V) at 980 nm and the other is a polarographic determination using a Np(IV)/Np(III) couple in a N H_2SO_4 medium ($E\frac{1}{2}$ = −0.3 V/ECS) after an electrolytic valence cycle. The operating procedures are described and the advantages of each method discussed. These methods are valuable mainly because of their specificity (which allows separations to be avoided in many cases) and their sensitivity, which permits the determination of neptunium at concentrations of the order of a few tens of mg/liter with a precision of a few percent. The principal disadvantage lies in the fact that they are relative methods calling for calibration and hence solutions titrated in neptunium. For this purpose two techniques are employed: controlled-potential coulometry using the Np(VI)/Np(V) couple and volumetry involving Np(VI) and Np(IV). In the latter case, after oxidation with silver oxide, an excess of iron(II) is added in a 4 to 5 N H_2SO_4 medium and determined by cerium(IV). The procedures are described and briefly discussed. Examples are given of applications, especially to solutions from reprocessing plants or pilot plants. The influence of the elements encountered most frequently in these solutions is considered. (auth)

55709 MASS-SPECTROMETRIC MEASUREMENT OF BURNUP IN UO_2 FUEL USING STABLE FISSION-PRODUCT NEODYMIUM. Qureshi, I. H.; Larsen, E.; Turi, L.; Olsen, J.; Hougaard, J. (Atomic Energy Commission Research Establishment, Risoe, Denmark). pp 503-11 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB-291; CONF-711107.

A method was developed for the mass spectrometric determination of neodymium, which does not require chemical separation of neodymium from the irradiated fuel. In this study, the fuel solution was spiked with enriched ^{145}Nd and the concentrations of ^{143}Nd and ^{146}Nd were determined by isotope dilution mass spectrometry. About 0.1 μg of neodymium is required to obtain an adequate ion current beam. For samples having low burnup (~0.1%), therefore, it is necessary to use 3 to 4 mg of the fuel for mass spectrometry. The maximum surface contact radiation dose of the samples varies from 200 to 400 mR/h. No interference from other nuclides was encountered in the measurement of ^{143}Nd, ^{145}Nd and ^{146}Nd. However, ^{144}Ce, ^{148}Sm, and ^{150}Sm interfere in the measurement of ^{144}Nd, ^{148}Nd, and ^{150}Nd. Therefore, only ^{143}Nd and ^{146}Nd were used for calculating the burnup. The reproducibility of the burnup measurement with this method was checked by replicate analyses of control samples. Burnup measurements were made on a number of irradiated UO_2 samples having burnup of 0.1 to 1.7%. The burnup values obtained from ^{143}Nd and ^{146}Nd showed about 2% variation between them. The burnup of a few samples was also determined by isotopic analysis of uranium and from the radioactive fission products ^{144}Ce and ^{137}Cs. Values obtained from the radioactive nuclides were lower than those obtained with neodymium. The neodymium method is rapid and simple and can be used on a routine basis. The concentration of plutonium in UO_2 fuel can also be determined simultaneously by spiking the sample with ^{242}Pu. The method is especially useful for measuring the distribution of burnup in fuel pins where a relatively large number of specimens have to be analyzed. (auth)

55710 SPECTROPHOTOMETRIC DETERMINATION OF CERIUM AND COBALT WITH SULPHOSALICYLIC ACID. Das, Ajit Kumar (Geological Survey of India, Calcutta). Indian J. Chem.; 10: No. 3, 306-7(Mar 1972).

A method is suggested for spectrophotometric determination of cerium and cobalt with sulfosalicylic acid. The minimum sulfosalicylate concentration for full color development is 0.24 M for cerium and 0.05 M for cobalt. The suitable pH range for both the reactions is 9.5 to 10.5. The cerium—SSA color was measured at 428 nm and the cobalt sulfosalicylate color at 380 nm. The sensitivity (Sandell) for the color reactions is 0.03 μg/cm^2 (cerium) and 0.013 μg/cm^2 (cobalt). Interferences of a large number of foreign ions were studied. (auth)

55711 VOLTAMMETRIC DETERMINATION OF URANIUM(VI) BY URANYL PEROXODICARBONATE OXIDATION. Zanello, Piero (CAMEN, Pisa, Italy); Raspi, Giorgio. Anal. Chim. Acta; 61: No. 2, 177-84(Sep 1972).

A method for voltammetric determination of uranium(VI) is proposed. In 1M sodium carbonate solution, the oxidation of the peroxide group in the $[UO_2(CO_3)_2(O_2)]^{4-}$ ion gives a well shaped anodic wave at a platinized platinum microelectrode with bubbling. The amplitude of this wave allows determination of uranium down to concentrations of 1×10^{-5} M even in the presence of Ce(III), Fe(III), Ni(II), molybdates, chromates, phosphates, fluoride, dissolved oxygen, and tributyl phosphate. The most serious interference arises from ions that catalyze the peroxide decomposition. (auth)

55712 ANALYTICAL SEPARATION OF RHENIUM BY EXTRACTION WITH N-BENZYLANILINE IN CHLOROFORM FROM SULFURIC ACID MEDIA. Khosla, M. M. L. (Defence Lab., Jodhpur, India); Rao, S. P. Anal. Chim. Acta; 61: No. 2, 239-45 (Sep 1972).

Analytical separation of rhenium(VII) is achieved by solvent extraction with N-benzylaniline in chloroform from sulfuric acid media. Few cations interfere; common anions such as phosphate, tartrate, citrate, oxalate, fluoride, EDTA, and ascorbic acid do not interfere. A simple method is described for separation of micro amounts of rhenium from macro amounts of molybdenum, tungsten, niobium, and tantalum. The method also separates rhenium from V, Cr, Se, Te, Os, Ru, Rh, Pd, and Pt. The molar absorptivity of rhenium thiocyanate complex in butyl acetate and diisopropyl ether is 40280 ± 280 at 430 nm. (auth)

55713 INTERFERENCE BY COPPER(II) IN DETERMINATION OF MOLYBDENUM(VI) USING TOLUENE-3,4-DITHIOL. Milham, P. J.; Maksvytis, Anne; Barkus, Balys (Biological and Chemical Research Inst., Rydalmere, Australia). Anal. Chem.; 44: No. 12, 2101-4(Oct 1972).

Microgram quantities of Mo(VI) are commonly determined spectrophotometrically after reaction with toluene-3,4-dithiol (H_2D) to form the green trisdithiolate (MoD_3). The effects of Cu, in the absence of masking agents, on this determination were studied. Individual and combined effects caused by variations in the concentration of Cu, Mo, and HCl are reported. Copper(II) was found to reduce the amount of extractable MoD_3 only if copper dithiolate is precipitated. The resulting loss of Mo is analytically significant for Cu to Mo ratios (w/w) as small as 1/1 in 0.5 to 5M HCl. Higher acid concentrations increase the Cu tolerance and with 10M HCl the interference is negligible at the highest Cu to Mo ratio tested (400/1). (J.G.B.)

55714 POSSIBLE DETERMINATION OF METAL IONS FROM THEIR FLUORESCENCE REACTIONS WITH MORIN ON A RING OVEN. Gertner, Antun; Kodrnja, Darinka; Pavisic, Dubravka; Grdinic, Vladimir (Inst. of Chemistry, Zagreb). Acta Pharm. Jugoslav.; 21: No. 3, 125-30(1971). (In Serbo-Croatian).

Ions of 11 elements were separated on filter-paper on a ring oven at 105° to 110° with 0.05M-HNO_3 as solvent; after exposure of the paper to NH_3 vapor, the ions were located with 0.02%

methanolic morin. Limits of detection (μg) from the fluorescence of the metal–morin complexes in 366-nm radiation were Al 0.006, As(V) 15, Be 0.005, Ca 0.5, Cs 15, La 0.1, Li 2, Mg 0.1, Pb 1, Sr 5, and Zn 0.2. Of the types of filter-paper examined, S. & S. grades 589[1] and 589[2] were preferred. On these papers, Mg, Sr, Li, Zn, Ca, La and Pb could be determined semi-quantitatively in amounts between 0.005 and 20 μg. (Anal. Abstr.)

55715 NEW REAGENTS FOR THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM. Mavrodin, Maria (Center of Chemical Physics, Bucharest). Rev. Roum. Chim.; 17: No. 7, 1199-1209(Jul 1972). (In French).

A quantitative study of the reactions of uranyl nitrate with 1-(2-hydroxy-4-sulfo-1-naphthylazo)-2-hydroxy-3-naphthoic acid (Calcon carboxylic acid), 3-(5-chloro-2-hydroxyphenylazo)-4,5-dihydroxynaphthalene-2,7-disulfonic acid (Eriochrom Blue SE), and 1-(2′-hydroxynaphthylazo)-2-napthol-4-sulfonic acid (Diamond Blue Black EB) has suggested the possibility of their use as reagents for the spectrophotometric determination of U(VI). In order to eliminate interferences it is recommended that a prior separation be carried out using anionic exchangers. (tr-auth)

55716 SPECTROMETRIC DETERMINATION OF ZIRCONIUM AND HAFNIUM WITH THE AID OF XYLENOL ORANGE. Karlysheva, K. F.; Koshel, A. V.; Vashun, L. F. (Inst. of General and Inorganic Chemistry, Kiev). Ukr. Khim. Zh.; 38: No. 5, 493-7(May 1972). (In Russian).

A spectrophotometric quantitative determination of combined Zr and Hf in solution, and of Hf in the presence of Zr, using xylenol orange is described. The optimum pH range was 0.8 to 1.0. The error of the determination is 2.7% for the two metals together; that for Hf alone was 1.6%, determined in an acidity of 1 N HCl. Impurities of Ti, Fe(III), and Al do not interfere. (tr-auth)

55717 INVESTIGATIONS OF CHANGES IN THE LUMINESCENCE INTENSITY OF URANIUM PEARLS WITH TIME. Basyrova, A. N.; Nikiforov, V. S. pp 238-42 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The luminescence intensity of uranium pearls prepared with NaF was found to change in time immediately from the moment they were prepared. This circumstance is the source of errors in determination of uranium by the luminescence method. In order to minimize the contribution of this source to the error of the determinations it is recommended that the instrument be graduated and the pearls measured 24 hours after their preparation for standard pearls and 72 hours for working pearls. Greater precision may be reached in determination of low uranium concentrations if measures are taken to enhance the stability of the pearl "base." (auth)

55718 SPECTROPOLARIMETRIC TITRATIONS OF THE LANTHANIDE METALS WITH D-(–)-TRANS-1,2-CYCLOHEXANEDIAMINETETRAACETIC ACID. Pearson, Karl H. (Cleveland State Univ.); Baker, Joyce R.; Reinbold, Paul E. Anal. Chem.; 44: No. 12, 2090-3(Oct 1972).

Successful spectropolarimetric titrations of the lanthanide(III) metal ions with D-(–)-trans-1,2-cyclohexanediaminetetraacetic acid (D-(–)-CDTA) are reported. The advantages of this titration method are its versatility, simplicity, rapidity of analyses, and applicability in solutions of high electrolyte concentrations. Each lanthanide metal ion except europium can be titrated using the same analytical procedure. The only change in the analytical procedure for europium(III) was that the titration had to be performed at 340 nm instead of 300 nm. (J.G.B.)

55719 DETERMINATION OF ALUMINUM AND CALCIUM IN THE HIGH-MELTING METALS TUNGSTEN AND MOLYBDENUM BY ATOMIC ABSORPTION SPECTROMETRY. Neumann, G. M. (Osram-Studiengesellschaft, Munich). Z. Anal. Chem.; 261: No. 2, 108-12(1972). (In German).

Results of the atomic absorption behavior of aluminum and calcium in tungsten and molybdenum are reported. There is a marked influence of the geometry of the burner on the interference of the matrix elements. Atomic absorption spectroscopy can be applied without prior separation procedures for the direct determination of aluminum and calcium in tungsten and in molybdenum. The sensitivity found was 0.3 μg Al/ml and 0.04 μg Ca/ml of solution or 3 ppM Al and 0.4 ppM Ca in the solid metal. (auth)

55720 LUMINESCENT REACTION COMPLEX FROM SALICYLAL-4-AMINOANTIPYRINE WITH ZIRCONIUM. Tashkhodzhaev, A. T.; Zel'tser, L. E.; Khikmatov, Kh. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 3, 22-4(1972). (In Russian).

The luminescent reaction complex formed by salicylal-4-aminoantipyrine (SAAP) and Zr ion is proposed as a basis for a quantitative determination of Zr. The complex contains the ratio of SAAP/Zr = 2/1, and its spectrum is a structureless band in the region 400 to 600 nm with a maximum at 554 nm. SAAP is quite selective as well as sensitive: 0.008 μg Zr/ml. (K.S.W.)

55721 AMPEROMETRIC METHOD FOR THE SEPARATE DETERMINATIONS OF YTTRIUM, CHROMIUM, IRON, THORIUM, AND MAGNESIUM IN ARTIFICIAL MIXTURES. Zhdanov, A. K.; Markhabaev, I. A. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 3, 25-7(1972). (In Russian).

Procedures are given for the analysis of the following ion mixtures: Y + Cr, Y + Cr + Fe, Y + Cr + Mg, and Th + Cr + Mg. Most of the procedures begin with oxidation of the Cr to dichromate with persulfate, and then dividing the solution into aliquots. Titration with a standard solution of Complexon III (Fe, Y, Th, Mg), titration with Mohr's salt (Cr), amperometric titration with Complexon III (Y), potentiometric titration (Y, Mg) are involved in special variants to obtain the desired data. (K.S.W.)

55722 INDIRECT POLAROGRAPHIC METHOD FOR DETERMINING ZIRCONIUM. Tserkovnitskaya, I. A.; Borovaya, N. S.; Tsvetkova, A. V. Vestn. Leningrad. Univ., No. 16, Fiz. Khim.; No. 3, 152-4(Aug 1971). (In Russian).

The polarographic determination of zirconium by limiting current of fumaric acid was developed. The method was used in analysis of melts containing chromium and zirconium. (auth)

55723 ATOMIC-ABSORPTION DETERMINATION OF MOLYBDENUM AND TUNGSTEN IN NIOBIUM-BASED ALLOYS. Saltykova, A. M.; Davidovich, N. K.; Melamed, Sh. G. (State Scientific-Research and Planning Inst. of the Rare-Metals Industry, Moscow). Zh. Anal. Khim.; 27: No. 6, 1216-18(Jun 1972). (In Russian).

The effect of the composition of the solutions, obtained after dissolving niobium alloys, on the atomic absorption of molybdenum and tungsten was studied. A change of the solution composition influences the atomic absorption of molybdenum less in the acetylene—air flame than in the acetylene—nitrous oxide one. Molybdenum was determined at the content of 1.7 to 2.7%, tungsten at that of about 5%. The variation coefficients are 1.5% for molybdenum and about 5% for tungsten. (auth)

55724 BISMUTHOLS AS ANALYTICAL REAGENTS. COMMUNICATION 5. AMPEROMETRIC TITRATION OF GOLD(III) BY MEANS OF 5-MERCAPTO-3-(NAPHTYL-2)-1,3,4-THIADIAZOLTHIONE-2. Busev, A. I.; Simonova, L. N.; Arutyunyan, A. A. (Moscow State Univ.). Zh. Anal. Khim.; 27: No. 6, 1209-12(Jun 1972). (In Russian).

The possibility was shown of the amperometric titration of gold(III) with 5-mercapto-3-(naphthyl-2)-1,3,4-thiadiazolthione-2 solutions. The proportionality between the diffusion current value and the gold(III) concentration is valid within 0.05 to 2.50 mg in 20 ml of the test solution. The composition of the complexes formed depends on pH of the solution and the acid normality. A method for the amperometric determination of gold(III) by its reduction current was developed and applied to the analysis of gold–tellurium ores. (auth)

55725 EFFECT OF TITANIUM ON THE DETERMINATION OF THORIUM WITH ARSENAZO(III) IN ACIDIC MEDIA. Nikolskaya, I. V.; Luk'yanov, V. F.; Maksimov, A. V. Zh. Anal. Khim.; 27: No. 6, 1212-14(Jun 1972). (In Russian).

A decrease of the optical density of a solution of the thorium complex with arsenazo III in the presence of titanium is caused by the interaction of titanium with arsenazo III. It decreases the excess of arsenazo III needed for the complete formation of the thorium complex. (auth)

55726 AMPEROMETRIC TITRATION OF SELENIUM AND TELLURIUM WITH THIOOXINE. Songina, O. A.; Zakharov, V. A.; Bessarabova, I. M.; Rakhimzhanov, P.; Safonov, I. I. (Kazahk State Univ., Alma-Ata, USSR). Zh. Anal. Khim.; 27: No. 6, 1121-4(Jun 1972). (In Russian).

The interaction of Se(VI, V, IV) and Te(VI, IV) in acid solutions (0.01 to 8M H_2SO_4) was studied. Se(VI) and Te(VI) do not interact with thiooxine; Se(IV) is reduced to the elementary state. Te(IV) is reduced by thiooxine to the elementary state in solutions with concentrations of H_2SO_4 of more than 4M. In a less acidic medium tellurium(IV) is reduced to Te(II), the latter forms a compound with thiooxine that is oxidized on a platinum electrode and is reduced on a mercury one. In a moderate acidic medium Te(IV) interacts with thiooxine at a molar ratio of 1:6. A possibility was shown for successively determining selenium and tellurium in technological samples. (auth)

55727 EXTRACTION-PHOTOMETRIC DETERMINATION OF SAMARIUM AND EUROPIUM IN THEIR MIXTURE WITH LANTHANUM. Poluektov, N. S.; Kamneva, T. N.; Lauer, R. S.; Ognichenko, S. F. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 27: No. 6, 1095-9(Jun 1972). (In Russian).

Ions of rare earth elements form complex compounds with bromopyrogallol red and N-benzoyl-N-phenylhydroxylamine, the compounds are extracted by water immiscible alcohols. Washing the extract obtained with a solution of nitrilotriacetic acid leads to complete decomposition of the lanthanum compounds; Ce, Pr, and Nd are decomposed partially, the compounds of the rest of the rare earths are not decomposed. An extraction-photometric method for determining samarium and europium in their mixture with lanthanum was developed using this phenomenon. The sensitivity of the method is 1 to 2% Sm(Eu) in $Sm_2O_3(Eu_2O_3) + La_2O_3$. (auth)

55728 COMPLEXONOMETRIC METHOD OF THE AMPEROMETRIC TITRATION OF SCANDIUM AND YTTRIUM. Zhdanov, A. K.; Markhabaev, I. A. (Tashkent State Univ.). Zh. Anal. Khim.; 27: No. 6, 1090-4(Jun 1972). (In Russian).

Conditions were studied for direct amperometric titration of scandium and yttrium with complexone III using a tantalum rotating electrode as an indicator. The reproducibility of the method, its accuracy, and the determinable minimum of the scandium and yttrium concentrations titrated were established. The effect of interfering cations and anions on the analytic results was studied. A possibility was shown for consecutive amperometric titration of the mixtures scandium—yttrium, thorium—yttrium and yttrium—magnesium with a solution of complexone III. (auth)

55729 DETERMINATION OF TELLURIUM BY OSCILLOGRAPHIC POLAROGRAPH. Tamba, M. G.; Vantini, N. Chim. Ind. (Milan); 53: No. 11, 1028-32(Nov 1971). (In Italian).

A method for the accurate analysis of Te in irons and steels based on an oscillographic polarograph with a scanning speed of 0.01 to 400 V/sec and a cell containing Hg, Pt, and calomel reference electrodes. Tellurium is separated from Fe and examined in H_2SO_4 solution. The effects of variables, including acid strength and concentration of surface active agents, were determined and the best conditions established. (Metals Abstr.)

55730 CHEMICAL DECOMPOSITION [AND ANALYSIS] OF SILICON-CERIUM-CALCIUM ALLOY. Engel, Oleg; Kral, Stanislav. Hutn. Listy; 26: No. 11, 830-2(Nov 1971). (In Czech).

The chemical analysis of Ce—Si—Ca alloy contained Al, Fe, Mn, C, P, S, and Mg. Carbon was determined by the Corleis method and S by iodometric methods both after burning in a stream of O at 1300°C. Manganese was determined according to Procter—Smith's method, P as phosphomolybdenum after the Ca and Fe separation by fusion in a Ni boat. Silicon was determined after fusing with $NaKCO_3$ and adding H_2O_2, Si was separated by leaching in water to leave SiO_2. For Al and Fe determination a complexometric method was applied. Curium was determined after precipitation by NH_3 in the presence of H_2O_2 as $Ce(OH)_3OOH$. (Metals Abstr.)

55731 SPECTROPHOTOMETRIC DETERMINATION OF YTTRIUM. Duarte, S. V.; Andrade, H. A. S.; Hainberger, P. L. (Pontifica Univ. Catolica, Rio de Janeiro). An. Acad. Brasil. Cienc.; 43: No. 3-4, 575-7(1971). (In Portuguese).

A method for the spectrophotometric determination of yttrium is presented that consists of dissolving the sample in hydrobromic acid and measuring at 320 mμ. The minimum detection limit is 18 μg/ml. The Y is separated from the interfering elements Os, In, Bi, Sb, Cu, V, U, Er, Hg, Fe, Cr, and Pt, by extraction with bis(2 ethylhexyl) phosphate. By utilizing the separation process Er and Y can be determined in the same sample. (tr-auth)

55732 QUANTITATIVE ANALYSIS OF VARIOUS MATERIALS BY LASER-MICROSPECTROSCOPY WITH AND WITHOUT Q-SWITCHED-TECHNIC. Schroth, H. (Siemens AG, Munich). Z. Anal. Chem.; 261: No. 1, 21-9(1972). (In German).

For investigating the possibilities of quantitative laser microspectroscopy in alloys and in oxide and sulfide materials, tests were carried out with a normal and a Q-switched laser. Calibration curves were determined for the elements: Mg, Al, Ni, Cu, Mo, and Ag. Using the relative standard deviations it could be demonstrated that the determinations obtained with Q-switched laser have more accuracy due to the smaller slope of the calibration curves. Moreover, it was ascertained that the reflectivity of metallic samples heavily influences results obtained with Q-switched and normal lasers. Sample inhomogeneities observable microscopically only injure the accuracy of the determinations. (auth)

55733 MARINE CHEMISTRY. VOLUME 1. ANALYTICAL METHODS. Second Edition Revised and Expanded. Martin, Dean F. New York; Marcel Dekker, Inc. (1972). 399p. $9.50.

Basic concepts and methods are reviewed. Pertinent calculations and concepts are discussed and keyed to the determinations that follow. Methods for analysis of selected micronutrients and related compounds are included. Analysis of polluted waters is described, along with analysis of sediments and selected organic matter. (M.C.G.)

55734 SMALL AMOUNT OF Mo AND Zn IN THE BAYER CYCLE. Papp, Elemer; Lovasi, Jozsef; Tomcsanyi, Laszlo; Zsindely, Sandor. Femip. Kut. Intez. Kozlem.; 10: 217-28 (1971). (In Hungarian).

A method was worked out for the determination of Mo and Zn present in the by-products of Bayer process and in the bauxites. Distribution of Mo and Zn in the Bayer cycle was investigated. It was established that the greater part of Mo remains in the cycle, and that part which is carried with the alumina departs during calcination because of the volatility of molybdenum oxide. In contrast to this, the larger part of Zn gets into the red mud, and the smaller part (about ⅓) contaminates alumina. For this reason, in case of processing bauxite with high Zn-content, alumina produced in the Bayer process contains Zn. (auth)

55735 DETERMINATION OF COPPER, IRON, LEAD, AND ZINC IN YTTRIUM OXIDE AND YTTRIUM OXIDE SULFIDE BY ATOMIC ABSORPTION SPECTROMETRY. Ishizuka, Toshio; Sunahara, Hiroshi; Tanaka, Kazuhiko (Government Industrial Research Inst., Nagoya, Japan). Jap. Anal.; 21: No. 7, 847-52(Jul 1972). (In Japanese).

The determination of copper, iron, lead, and zinc as impurity elements in yttrium oxide and yttrium oxide sulfide by extraction with ammonium pyrrolidine dithiocarbamate (APDC)—methyl isobutyl ketone (MIBK) and atomic absorption spectrometry was studied. The experimental conditions are: the analytical lines are 3247 Å for copper, 2483 Å for iron, 2833 Å for lead, and 2139 Å for zinc, and the combustion gas flow rates are 10 l/min for air and 0.7 l/min for acetylene. The most suitable pH for the extraction of these metals is 3 to 4. The relationships between the volume ratio (R) of the aqueous solution of each metal ion to MIBK and the extraction ratio are studied. Copper and lead are extracted over 98% at R = 2, and 90% at R = 10. Iron and zinc are extracted 85% and 80% at R = 2, and 60% and 15% at R = 10, respectively. Although the extractions of iron and zinc are not satisfactory at R = 2, the reproducibility of extraction of iron is within ±4% and that of zinc is within ±3%, and therefore these extractions are carried out at R = 2. The extraction of each metal is not affected by the presence of a large amount of yttrium. The sensitivities of these metals in atomic absorption spectrometry are higher when they are in MIBK than in aqueous solutions. The sensitivity of copper, iron, and zinc increases about 7 times and that of lead increases 9 times when R = 2. (auth)

55736 SPARK SOURCE MASS SPECTROMETRIC SENSITIVITY FACTORS FOR ELEMENTS IN DIFFERENT MATRICES. Hamilton, E. I.; Minski, M. J. (National Radiological Protection Board, Sutton, Eng.). J. Mass Spectrom. Ion Phys.; 10: No. 1, 77-84(Nov 1972).

Spark source mass spectrometry sensitivity factors for the elements, defined as the ratio, (Measured concentration of an element in a Standard A/Certified concentration of an element in Standard A), have been determined for several elements (including B, C, P, S, Ti, V, Cr, Mn, Ni, Co, Ge, As, Zr, Nb, Mo, Ag, Sn, Ta, W, Li, Na, Mg, Al, Si, K, Ca, Fe, Zn, Ga, Sr, F, Cu, Br, Rb, Y, Cs, Ba, La, Ce, Pr, Sm, Tb, Tl, Pb, Th, U, Se, and Cd) in various certified standard materials of different gross chemical composition. Stress is placed on the application of the spark source mass spectrometer for the simultaneous assay of many elements present in biological matrices. (auth)

55737 THEORY AND APPLICATIONS OF ION-SELECTIVE ELECTRODES. Koryta, Jiri (Heyrovsky Inst. of Physical Chemistry and Electrochemistry, Prague). Anal. Chim. Acta; 61: No. 3, 329-411(Oct 1972).

A review of theory and applications of ion-selective electrodes is presented. After a full discussion of the theoretical background the general technology of ion selective electrodes is described. Solid-state electrodes, liquid ion-exchanger, and macrocyclic carrier electrodes are reviewed. Determination of various elements by this method is considered. (713 references) (auth)

55738 CONTAMINATION CORRECTION FOR THE DOUBLE-SPIKE LEAD METHOD. Knight, R. J.; Tatsumoto, Mitsunobu (Geological Survey, Denver, Colo.). U. S., Geol. Surv., Prof. Pap.; No. 800-C, 215-19(1972).

A refinement of the double-spike method for isotopic analyses for low-level lead was developed. This is a mathematical analysis that can correct for experimental contamination, as well as for variable mass fractionation. This refinement can mathematically establish when the blank is significant. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 55900, 56106, 56487, 56496, 56507, 56509, and 56525.

55739 (COO-3236-3) NUCLEAR CHEMISTRY AND GEOCHEMISTRY RESEARCH, CARNEGIE-MELLON UNIVERSITY.

Progress Report, 1971–1972. Kohman, Truman P.; Karol, Paul J. (Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Chemistry). 31 May 1972. Contract AT(11-1)-3236. 81p. Dep. NTIS.

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55740 (EUR-4870) ISOLATION AND DETERMINATION OF ^{231}Pa IN URINE. Camera, V. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Aug 1972. 20p. (In Italian). Dep. NTIS (U. S. Sales Only). EUR FB 40.-.

A method for determination of protactinium-231 in urine is described. The procedure involves separation of the radionuclide on a chromatography column of mitene (polyethylene) supporting a solution of tri-n-octylphosphineoxide (TOPO) in cyclohexane. The method is sensitive and selective and yields highly reproducible results. (auth)

55741 (NIRS-Pu-7, pp 53-6) LIQUID SCINTILLATION COUNTING OF PLUTONIUM IN BIOLOGICAL SAMPLES. Joshima, Hisamasa; Matsuoka, Osamu (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

A liquid scintillation counting method without ashing procedure was established for plutonium in animal tissues with a commercially available tissue solubilizer. Samples of normal mouse liver, lung, lymph node, and blood, containing up to 250 mg of wet weight, were placed in low-potassium glass counting vials. After addition of 2 ml of sample solubilizer, each sample was digested at about 38°C for 24 hrs. When entirely digested, each sample was spiked with a standard solution of monomeric Pu and then 10 ml of toluene scintillator was added. With a liquid scintillation spectrometer, the optimal gain setting for these Pu-spiked quenching samples was selected for routine analyses. By using the relation between the external standard ratio and the position of the pulse height valley that lies between the β and α peaks of Pu, the counting window can be set for each sample with a variable discriminator. The alpha counting efficiency of Pu in the biological sample was not affected by the degree of quenching level in each sample if the window setting was adequate. Even when samples were counted with an identical fixed window setting, the alpha counting efficiency of Pu was hardly affected. So identical fixed window settings have sufficient accuracy. This method is safer and less laborious than the ashing method, and permits more analyses per experiment. (auth)

55742 (NIRS-Pu-7, pp 78-9) STUDY ON BIOASSAY OF PLUTONIUM. Okabayashi, Hiroyuki; Suzuki, Masashi (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

Measurement of ^{239}Pu in feces was studied. The sample was completely digested with HNO_3 and H_2O_2 and Pu was separated from other obstacles using an anion exchange resin (Dowex 1x 8), electrodeposited on a stainless steel disk, and then the disk was counted for Pu. The recovery of 77 to 92% was obtained from spiked samples in the level of 10^{-12} to 10^{-11} Ci per sample. This method is applicable to other biological samples. (auth) (Japan)

55743 SIMPLIFIED SEPARATION OF STRONTIUM, RADIUM, AND LEAD FROM ENVIRONMENTAL MEDIA BY PRECIPITATION FOLLOWED BY FRACTIONAL ELUTION. Gregory, Lloyd P. (National Radiation Lab., Christchurch, N. Z.). Anal. Chem.; 44: No. 12, 2113-5(Oct 1972).

The insolubility of $Sr(NO_3)_2$ in strong HNO_3 is commonly used to effect the separation of Ca from strontium (and related elements, Pb, Ba, Ra) in water, soil, food ash, or bone ash samples. The sequential separation of ^{210}Pb, ^{90}Sr, and ^{226}Ra from Ca was carried out by cation exchange following reaction with 70% HNO_3. Fractional elution was effected by ammonium acetate, ammonium lactate, and alkaline EDTA, respectively. Radioactivity was determined by counting techniques. (J.G.B.)

55744 DETERMINATION OF TRACES OF PHOSPHORUS BY A RADIOMOLYBDENUM METHOD. Kenney, J. E.; Menon, M. P. (Savannah State Coll., Ga.). Anal. Chem.; 44: No. 12, 2093-5(Oct 1972).

A radioreagent method was developed for the relatively simple and sensitive determination of traces of phosphorus in steel and other samples. Sodium molybdate labeled with ^{99}Mo is the radioreagent used to convert phosphate ions, in the presence of acid, to active phosphomolybdic acid. The active reaction product is extracted into a 1-butanol—chloroform mixture and the γ activity of a portion of the extract is measured and related to phosphorus concentration in the sample. Vanadium and titanium were found to interfere. (J.G.B.)

55745 CHEMICAL ANALYSIS OF RADIOACTIVE NUCLIDES BY CO-PRECIPITATION METHOD. I. CHEMICAL ANALYSIS OF RADIOACTIVE NUCLIDES IN SEA WATER BY CO-PRECIPITATION WITH FERRIC HYDROXIDE USING PYRIDINE AS PRECIPITANT. Koda, Yoshio (Government Industrial Research Inst., Nagoya, Japan); Iwashima, Kiyoshi; Koyanagi, Taku; Watari, Kazuo; Izawa, Masami. Radioisotopes (Tokyo); 21: No. 8, 473-7(Aug 1972). (In Japanese).

A method of separation and spectrometric analysis of long-lived radionuclides in seawater, to be released from nuclear installations, was investigated using a NaI(Tl) scintillator. When coprecipitation of the nuclides with hydrated ferric hydroxide was carried out by adding pyridine instead of ammoniacal water, ^{59}Fe, ^{95}Zr, ^{144}Ce, and ^{106}Ru could be coprecipitated with >95% yield, while ^{90}Sr and ^{137}Cs were not precipitated at all. Coprecipitation of ^{60}Co and ^{65}Zn was slight. The results can be explained by the fact that the pH of the solutions during precipitation could be adjusted to 6 to 7 easily and accurately, and that a few of the metal ions formed their pyridine complexes. Experiments with varying the amounts of pyridine and/or Fe added to seawater revealed the coprecipitation behaviors of each radionuclide in detail. (auth)

55746 ANALYSIS OF PLUTONIUM OXIDE. Srinivasan, N.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Trombay, India). pp 187-201 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB-291; CONF-711107.

Analysis of plutonium oxide produced in the Trombay reprocessing plant is described. The plutonium content is estimated by two methods, potentiometric and coulometric, both modifications of methods reported in the literature. Both have an accuracy and precision of 0.2%, and analysis of over 300 samples showed an agreement of 0.2 to 0.5% between the two methods. Plutonium-238 which is low in concentration is estimated by the standard alpha spectrometric method after separation of americium-241. Mention is also made of the mass spectrometric method for the estimation of plutonium. Traces of impurities in plutonium, including some common rare earths, uranium, and americium, were determined by the emission spectrographic method after removal of plutonium by ion exchange absorption. The emission spectrographic method developed using LiF–AgCl carrier dc arc has much lower detection limits than those reported in the literature for dc arc methods for a number of elements, particularly Eu, Gd, Dy, etc. The precision of the method varies from 7 to 20% for different elements. (auth)

55747 DETERMINATION OF THE PLUTONIUM CONTENT OF A MIXED PLUTONIUM/URANIUM OXIDE BY CALORIMETRY. Meniere, J.-M.; Ganivet, M. (CEN, Cadarache, France). pp 203-15 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Measurement of the calorific energy liberated absorption of alpha particles emitted by the various plutonium isotopes permits a nondestructive determination of that element in its compounds (particularly in oxides and mixed oxides). The method used is described and how the accuracy of the results depends on knowledge of the isotopic composition of plutonium and its americium content is shown. An accuracy of between ±0.1 and ±0.5% can be obtained and the reproducibility of the measurements is better than 0.1%. (auth)

55748 ANALYSIS FOR URANIUM AND PLUTONIUM IN FUEL MANUFACTURE AND FUELS. Falta, G.; Knotik, K.; Sorantin, H. (Reactor Center, Seibersdorf, Austria). pp 269-77 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Analytical work in the Reactor Centre Seibersdorf dealing with unirradiated fuels for high-temperature gas-cooled reactors (U, Th)C$_2$, UO$_2$, (U, Th)O$_2$, coated with pyrocarbon and pyrocarbon/silicon carbide, and with compacted fuels, is briefly reviewed. Newly developed chemical and electrochemical disintegration methods for compacted fuel bodies and for separating coated fuel particles from graphite matrices are described. Some methods for pre-treatment of coated particles and extraction of the fissile material, and methods for determination of uranium, e.g. volumetry, polarography, α-counting by liquid scintillation, are also discussed. (auth)

55749 AUTOMATIC ANALYSIS OF URANIUM AND PLUTONIUM IN SOLUTIONS. von Baeckmann, A. (Nuclear Research Center, Karlsruhe, Ger.); Neuber, J.; Wilhelmi, M.; Koch, L. pp 329-41 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

The analysis of uranium and plutonium solutions, for example, at the head-end of a reprocessing plant, is of significance to the plant operator, the owner of the material, and the inspection agency. It is important to have the analytical results available as quickly as possible and to be able to verify them by counter-analyses at a later date. Efforts were made to set up a system based on x-ray fluorescence analysis and mass spectrometry that satisfies these requirements. The system consists of the following parts: (1) Automatic sample preparation stage in which exactly weighed amounts of the sample solutions are mixed with known amounts of thorium, and aliquots of the samples are taken both for mass spectrometric isotopic dilution analysis and for determination of the uranium and plutonium concentrations by x-ray fluorescence spectroscopy. (2) Automated x-ray fluorescence spectrometer for the rapid determination of the uranium and plutonium concentrations in the prepared sample by comparison with an internal thorium standard. (3) Central laboratory with an automated mass spectrometer for subsequent measurement of the ratio between uranium and plutonium isotopes and thorium; to prevent the samples from undergoing changes during storage, they are dried in small aluminum capsules in the sample preparation stage. The design of the system is described and its advantages, especially for purposes of nuclear safeguards, are outlined. (auth)

55750 SIMULTANEOUS DETERMINATION OF URANIUM AND PLUTONIUM BY X-RAY FLUORESCENCE IN THE REPROCESSING OF RAPSODIE FUEL. Malet, G.; Charpentier, G. (CEA, de la Hague, France). pp 343-52 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

The method of x-ray fluorescence spectrometry, used for determining uranium in the aqueous and solvent phases, was extended to determinations of uranium and plutonium in reprocessing solutions of Rapsodie fuel, the activity of which does not exceed 1 Ci/liter. They use a Sigma 80 apparatus provided with a tungsten anticathode tube and a LiF-crystal analyzer (110). The samples are analyzed, considering their content (1 to 20 g/liter), through a plexiglas container. The method of analysis consists in using an internal standard (yttrium) and two reference standards covering the concentration range to be measured. An interface, which is being designed, will make it possible to connect the spectrometer directly with a PDP 8/1 computer. Use of three reference standards permitting a parabolic interpolation is also envisaged. Samples are taken with the help of an automatic sampler and, after addition of the internal standard, sent through a pneumatic tube into the "receiving" glovebox, where they are positioned in the spectrometer. The method has excellent reproducibility (1%) for industrial control, and comparison over the whole range of analyses with the analysis of the final balance shows a deviation lower than 1%. (auth)

55751 DETERMINATION OF PLUTONIUM, AMERICIUM, CURIUM, AND PLUTONIUM VALENCY IN RAFFINATE SOLUTIONS FROM IRRADIATED PLUTONIUM FUELS REPROCESSING. Savage, D. J.; Drummond, J. L. (Dounreay Experimental Reactor Establishment, Thurso, Scotland). pp 409-19 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

The determination of plutonium and other actinides in the aqueous waste solution (raffinate) from the first cycle of a TBP extraction process is described. When the chemical reprocessing plant is operating normally, determination of total plutonium is satisfactory for routine process control. In the method proposed for analysis of PFR fuel reprocessing solutions, a sample of the raffinate is chemically treated to adjust all forms of plutonium to the tetravalent state. The plutonium is separated from americium and curium by extraction into a solution of TTA in xylene and counted by α spectrometry. Americium-241 and curium-242 can be measured by α spectrometry on the original diluted sample. Determination of the higher isotopes of these elements requires separation of americium from curium; possible procedures are discussed. It is important to identify the valency of the residual plutonium in the raffinate during the current phase of small-scale process development studies. Valency determination will also be useful if unacceptably high plutonium levels are found in the raffinate from the plant process. Laboratory tests on simulated solutions free from fission products showed that it is possible to adapt the procedure for total plutonium to the measurement of individual valency states, making use of the specific extraction of tetravalent species by TTA. Plutonium (IV) originally present is extracted from the untreated diluted sample. The residual aqueous phase is treated with vanadium (V) to oxidize plutonium (III) to (IV), which is then extracted. Finally, ferrous iron followed by vanadium (V) is used to reduce plutonium (VI) to (IV), which is extracted in turn. Aged colloidal plutonium requires special treatment with strong acids to render it extractable. A satisfactory plutonium detection limit can be attained by dilution of the sample in a remote handling facility to an activity level which can be handled with local shielding during the conditioning and separation procedures. Details of the procedure are given. (auth)

55752 DETECTION AND ANALYSIS OF ACTINIDE CONTAMINANTS IN ^{239}Pu. Zimmer, W. H.; Campbell, M. H. (Atlantic Richfield Hanford Co., Richland, Wash.). pp 421-32 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Lithium-drifted germanium detectors provide a convenient means for detecting the presence of actinide contaminants in plutonium-239-bearing materials as varied as fuel elements or waste. Nondestructive qualitative and quantitative analyses can be performed with minimum interference. Data are presented showing detection and analysis of gamma emissions from uranium-235 and uranium-237; and the daughter radioisotope gamma emissions from protactinium-233 (neptunium-237), protactinium-234m$_1$ (uranium-238), and thallium-208 and lead-212 (uranium-232 and thorium-232). In a plutonium-239 media there will be enough emission from these actinide contaminants for a Ge(Li) detector to be qualified as the single analytical tool that will detect these contaminants at the parts per million level. Plutonium-239 activity in the material matrix provides all needed information for a self-absorption correction. Measurement precision and detection limits are presented for the above actinide radioisotopes. (auth)

55753 DETERMINATION OF FISSION PRODUCTS BY ISOTOPIC DILUTION. Frejaville, G.; Lucas, Monique (CEN, Saclay, France). pp 473-83 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Application of the isotopic dilution technique to determination of two fission products, cesium and neodymium, is described. Isotopic dilution with a simple tracer is applied to determination of fission cesium in the sodium coolant of fast reactors. The same method, with a triple tracer, is used for simultaneous determinations of fission plutonium and neodymium in irradiated nuclear fuels. The chemical procedures needed to obtain the product for isotopic analysis as well as the preparation and calibration of the tracer are described. The conditions for analysis by thermo-ionization mass spectrometry are defined. Methods of allowing for natural contamination are discussed. The following results were obtained on a routine basis: determination of the ^{148}Nd/^{238}U ratio in the 5 to 5000 atomic ppM concentration range with a relative uncertainty (2σ) of ±1%, and determination of concentrations of cesium-137 of the order of 10^{-10} g per gram of sodium with a relative uncertainty (2σ) of ±2%. (auth)

55754 NEW POSSIBILITY FOR NONDESTRUCTIVE BURNUP DETERMINATION. Ramthun, H.; Debertin, K. (Physikalisch-Technische Bundesanstalt, Brunswick). pp 485-90 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Nondestructive determination of the burnup of fuel elements by measuring fission product γ rays has become common practice in many laboratories. The thermal power produced by β and γ radiation of the fission products has not been utilized for this purpose. Though numerous fission nuclides contribute to the total heat output of a spent fuel element, the thermal power (P) dissipated in a properly designed calorimeter can be used as a measure of the burnup value (B). The relation between P and B includes fission yields, mean β energies, fractions of γ energies absorbed in the calorimeter, irradiation history, and cooling time. The burnup can be evaluated by means of a computer program from one single measurement of thermal power as well as from a series of measurements spread over a period of at least 14 days. For measurement of small fuel samples, an adiabatic calorimeter was designed and constructed. The results obtained with MTR-fuel specimens are presented; they agree well with those of other burnup determination methods. (auth)

55755 GAMMA SPECTROMETRIC AND MASS SPECTROMETRIC DETERMINATION OF BURNUP. Krtil, J. (Inst. of Nuclear Research, Rez, Czech.); Krivanek, M.; Bulovic, V.; Djordjevic, M.; Maximovic, Z. pp 491-502 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Gamma and mass spectrometric methods for determining some important burnup data (total burnup, number of fissions corresponding to ^{235}U and ^{239}Pu, integral neutron flux) were experimentally tested and are discussed. Gamma spectrometric methods are based on isolation of ^{137}Cs(^{134}Cs), ^{144}Ce, and ^{106}Ru from solutions of irradiated uranium by means of selective separation methods (extraction, distillation) and subsequent measurement of the gamma spectra. The burnup parameters were calculated from the absolute activity obtained and the known physical and reactor constants. Mass spectrometric measurement of all stable isotopes of neodymium was also used for determination of the above burnup characteristics. The amounts of individual isotopes of neodymium were determined by isotope dilution after chemical separation. The practical usefulness of the experimental methods developed and of the quantitative relationships used was verified by the determination of the burnup of an irradiated sample of metallic uranium nuclear fuel. (auth)

55756 IMPROVED POST-IRRADIATION ANALYSIS FOR BURNUP AND HEAVY ISOTOPE CONTENT. Koch, L.; Cricchio, A.; Gerin, F. (European Inst. for Transuranium Elements, Karlsruhe, Ger.). pp 523-36 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Post-irradiation analyses performed at the European Institute for Transuranium Elements were improved with regard to accuracy and to further reduction in analytical cost. Alpha and mass spectrometry combined with isotope dilution were used to determine burnup and the quantity of heavy isotopes in nuclear materials. A system of methods is described, which covers the quantitative isotope analysis of uranium-(232, 233, 234, 235, 236, 238), neptunium-237, plutonium-(236, 238, 239, 240, 241, 242), americium-(241, 242, 243), Cm isotopes, Cf isotopes, and stable or radioactive fission products relevant to burnup analysis. With regard to improvement of accuracy, the intrinsic coherence of isotopic abundance in irradiated nuclear material makes a consistency check of analytical data possible in two ways: (1) The quantities of all present and fissioned heavy isotopes must be balanced by the fuel weight; this check can detect systematic errors in vessel calibration, sampling, etc. (2) Ratios of fission products or heavy nuclides can be correlated with burnup and isotope quantity, which provides an additional means to discover systematic errors, e.g., in isotope dilution analysis. Post-irradiation analysis can be limited to either one of these methods. For reduction of cost, the chemical conditioning of samples for isotope analysis was simplified, e.g., the number of separation steps for neodymium-148 analysis was reduced. An automatically operated ion exchange column was developed; data handling as well as partial operation of alpha and mass spectrometers are also automated. A computer program calculates burnup and heavy isotope quantities. (auth)

55757 ACTINIDE COMPOSITION STUDIES ON THORIUM/URANIUM FUEL ELEMENTS WITH KNOWN IRRADIATION DATA. Wenzel, U.; Riedel, H.-J. (Kernforschungsanlage, Juelich, Ger.). pp 549-62 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Neutron irradiation of thorium/uranium fuel elements yields many long-lived actinide nuclides. Apart from the desired ^{233}U, other U isotopes and isotopes of Pa, Np, and Pu are also formed. Since these nuclides partially interfere with the refabrication of the nuclear fuel, a knowledge of their formation rates is of great interest. Studies were performed on single Thorium High Temperature Reactor (THTR) fuel element spheres in order to isolate these nuclides and determine their quantities. Neutron flux, irradiation time, and original composition were known for each fuel element. Before destruction of the spheres, their burnup was determined. After combustion and dissolution of the fuel spheres and protactinium separation, the actinides were separated from the fission products using column extraction chromatography and isolated using ion exchange and extraction processes. Several analytical methods were used for the determination of the actinides. Data of 18 separate experiments with fuel spheres of different burnup are presented and discussed. (auth)

55758 DETERMINATION OF BURNUP IN THE HIGH TEMPERATURE REACTOR FUEL CYCLE. Fudge, A. J.; Foster, E.; Banham, M. F.; Prior, H. A. (Atomic Energy Research Establishment, Harwell, Eng.). pp 563-73 of Analytical Methods in the Nuclear Fuel Cycle. Vienna; International Atomic Energy Agency (1972).

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971). See STI/PUB—291; CONF-711107.

Requirements for the determination of burnup in fuel materials irradiated in a high-temperature gas-cooled reactor fuel cycle have given rise to a number of chemical, radiochemical, and nuclear problems. Materials irradiated at these higher temperatures are much more resistant to chemical attack, and consequently much greater emphasis was placed on nondestructive method of examination. The determination of the total number of fission events and of the ratio of the fissions from different nuclides was made on individual coated particles by high-resolution gamma spectrometry using a Ge(Li) diode detector. This approach, and others using radioactive fission products, was subject to large errors when applied to material in which breeding has occurred.

The determination of the distribution of burnup by gamma scanning was achieved successfully but the precision of the technique was affected by problems of homogeneity. In destructive analysis, extensive chemical dissolution studies were carried out in order to achieve a satisfactory solution of the irradiated fuel material. Electro-hydraulic crushing, followed by a high-pressure dissolution procedure, was used to obtain the complete solution of specimens. The standard methods of burnup determination using heavy element isotopic analysis and radioactive and stable fission product analysis were then applied successfully to several types of fuel material arising from the high-temperature reactor fuel cycle. Nuclear problems arising from uncertainties in the cross-section data of the heavy element nuclei and fission products were investigated, together with variation of fission yield with neutron energy. Comparisons were made between the burnup values obtained for many different types of irradiated fuel material by the different methods and with values obtained from the reactor physics predictions. (auth)

55759 DETERMINATION OF ^{65}Zn AND ^{54}Mn IN SEA WATER. Shah, S. M.; Rao, S. R. (Bhabha Atomic Research Centre, Bombay). Curr. Sci. (India); 41: No. 18, 659-63(20 Sep 1972).

Zn and Mn are coprecipitated from seawater with iron hydroxide. Iron is removed by extraction using methyl isobutyl ketone. Zinc is separated by using anion exchange. Manganese is extracted using chloroform after complexing permanganate with tetraphenylarsonium chloride. Gamma spectra are counted. Radiochemical separation of ^{65}Zn and ^{54}Mn from other fission products was complete. The amounts of ^{65}Zn and ^{54}Mn present in organic form were determined. (M.C.G.)

55760 LOSS OF RADIONUCLIDES IN MARINE ORGANISMS DURING THERMAL DECOMPOSITION. Nakamura, R.; Suzuki, Y.; Kawachi, E.; Ueda, T. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 13: No. 3, 149-55(Sep 1972).

The losses of ^{137}Cs, ^{106}Ru—^{106}Rh, ^{65}Zn, ^{60}Co, ^{59}Fe, ^{54}Mn, ^{95}Zr—^{95}Nb, and ^{114}Ce from tissues of bivalves and green algae during dry ashing were investigated at temperatures of 450, 550, or 800°C and ignition times of 12, 24, or 48 hours. Samples were prepared by rearing the organisms in seawater containing each radionuclide. Biological tissues were decomposed in an electric muffle furnace. Recoveries of individual radionuclides in the tissues were calculated by the radioactivity ratio of pre- and post-ashing of samples. Under the condition of 450°C, ignition was not complete in 24 hours for bivalves and in 12 hours for green algae. ^{137}Cs, ^{106}Ru—^{106}Rh, ^{65}Zn, and ^{60}Co showed losses in some ashing conditions and the manners of loss were different between the organisms. ^{59}Fe, ^{54}Mn, ^{95}Zr—^{95}Nb, and ^{144}Ce were not significantly lost under any condition used. Loss of ^{137}Cs, ^{106}Ru—^{106}Rh, ^{65}Zn, and ^{60}Co might be correlated with the biological matrix in which these radionuclides were incorporated, while there seemed to be no effect of biological matrix to the ashing loss of ^{59}Fe, ^{54}Mn, ^{95}Zr—^{95}Nb, and ^{144}Ce. The most desirable ashing condition in the investigation was 450°C, 48 hours for ^{137}Cs and 550°C, 12 hours for other radionuclides in bivalves, and 450°C, 24 hours for ^{137}Cs, ^{106}Ru—^{106}Rh and ^{65}Zn, and 550°C, 12 hours for other radionuclides in green algae. (auth)

55761 ANALYTICAL METHODS FOR ^{106}Ru IN MARINE SAMPLES. Iwashima, K. (Inst. of Public Health, Tokyo). J. Radiat. Res.; 13: No. 3, 127-48(Sep 1972).

Analyses for ^{106}Ru in marine environmental samples, which are useful for monitoring within a control context, were developed. The quantity and the quality of the samples applied for the analyses are as follows: two l of seawater filtered through a millipore filter of 0.45 μm pore size; two g (wet weight) of bottom sediments prepared by sieving in seawater; or the edible part of marine organisms equivalent to ca. 1 g ash. In order to equilibrate ^{106}Ru in the samples with ruthenium carrier and to dissolve the samples completely, marine organisms and sediments were ashed at 400 to 500°C, and then fused with a mixture of potassium hydroxide and potassium nitrate. Seawater was heated in the presence of an oxidant in an alkaline medium. Ruthenium was extracted with carbon tetrachloride as ruthenium tetroxide, and then back-extracted with sodium hydroxide solution containing a reducing agent. Hydrous ruthenium oxides were precipitated from the extract and subjected to β-activity measurement with a low background gas-flow counter by use of a 40 mg/cm^2 aluminum absorber. The loss of ruthenium throughout ashing and chemical procedures was found to be negligibly small by a tracer experiment. Chemical yields were 89 ± 5% and the ratio of chemical and radiochemical yields was 0.98 ± 0.03. Sensitivity of the method (3 σ) is 0.2 pCi and the whole chemical procedure takes 3 to 4 hours. A rapid γ-spectrometric technique for ^{106}Rh was also developed in which ^{106}Ru was coprecipitated with cobalt sulfide from seawater. (auth)

55762 NEW METHOD FOR PRODUCTION OF ROSS FILTERS FOR RADIOISOTOPIC X-RAY FLUORESCENCE ANALYSIS. Havranek, E.; Bumbalova, A. (Comenius Univ., Bratislava). Z. Phys. Chem. (Leipzig); 250: No. 1-2, 73-84(1972). (In German).

A method for production of differential Ross filters used in radioisotopic x-ray fluorescence analysis by pressing of powdered material with filler is described. The filters produced this way (Sn, Cd) were used for determination of iodine in matrices with various bromine contents. The results obtained were compared with results of measurements using a filter pair. Usefulness of the filter is discussed. (M.C.G.)

55763 SELECTIVE DETERMINATION OF ^{231}Pa IN BIOLOGICAL SAMPLES. Camera, V. (Joint Nuclear Research Centre, Ispra, Italy). Radiochem. Radioanal. Lett.; 11: No. 3-4, 153-64(15 Sep 1972). (In French).

A method for determination of ^{231}Pa in urine is described. The procedure involves separation of the radionuclide on a chromatographic column of polyethylene powder supporting a solution of tri-n-octylphosphine oxide (TOPO) in cyclohexane and α counting of the separated solution. The method is sensitive and selective and yields highly reproducible results. (auth)

55764 SIMPLIFIED OXYGEN BOMB COMBUSTION PROCEDURE FOR ^{14}C IN AGRICULTURAL MATERIALS AND SOILS. Hilton, H. W.; Nomura, N. S.; Kameda, S. S. (Hawaiian Sugar Planters' Association, Honolulu). Anal. Biochem.; 49: No. 1, 285-9(Sep 1972).

A procedure described by Sheppard and Rodegker (Anal. Biochem., 4, 246(1962)) was modified by eliminating the CO_2 entrainment system outside the bomb by placing a KOH solution inside the bomb chamber and by precipitating the ^{14}C from aliquots of the K_2CO_3—KOH mixture as $Ba^{14}CO_3$ directly in scintillation counting vials. The quenching and self-absorption of ^{14}C in the $BaCO_3$ particles suspended in the thixotropic gel-phospher media were investigated. An ultrasonic bath was used to complete gel formation and assure uniformity. Analysis of standard samples showed at over 90% of the specified activity could be measured. (auth)

55765 REACTION OF ACENAPHTHYLENE VAPOR IN THE PRESENCE OF POLYMER FILMS UNDER γ- OR ULTRAVIOLET-IRRADIATION. Hayakawa, Kiyoshi; Kawase, Kaoru; Yamakita, Hiromi (Government Industrial Research Inst., Nagoya, Japan). J. Polym. Sci., Part A-1; 10: No. 8, 2463-7(Aug 1972).

The possibility of vapor-phase grafting of acenaphthylene (ANTL) on polyethylene, nylon 6, and ethyl cellulose films by γ and uv irradiation was studied. Results show that the dimer of ANTL accumulated on the uv irradiated films in the atmosphere of ANTL, and the expected formation of polymer layer or grafting reaction did not occur. With γ-rays the grafting was achieved both in the absence and in the presence of air. Comparison is made of γ-ray graft copolymerization by vapor- and liquid-phase methods. It was concluded that it seems probable that the graft copolymer produced by the vapor-phase method has shorter branches, while that by liquid-phase method has longer branches. (D.H.M.)

55766 INDUSTRIAL APPLICATIONS OF RADIONUCLIDE X-RAY FLUORESCENCE ANALYSIS. Svitel, Juraj; Herchl, Miroslav (Comenius Univ., Bratislava). Jad. Energ.; 18: No. 9, 302-11(Sep 1972). (In Czech).

Prospects in radionuclide x-ray fluorescence analysis are reviewed and demonstrated on concrete examples of industrial and laboratory applications. (auth)

55767 APPLICATION OF THICK-SOURCE ALPHA PARTICLE SPECTROMETRY TO THE DETECTION OF DISEQUILIBRIUM IN THE RADIOACTIVE DECAY SERIES OF ^{238}U IN ROCKS AND MINERALS. Killeen, Patrick George. London, Ont.; Univ. of Western Ontario (1971). National Library of Canada, Ottawa.

Thesis.

Although the analysis of rocks for uranium content by gamma spectrometry is a rapid and efficient method it depends on the crucial assumption that the ^{238}U decay series is in radioactive equilibrium. A method of detecting the presence of disequilibrium in the ^{238}U decay series was developed. A silicon semiconductor detector and a 1024 channel pulse height analyzer were used to obtain over 250 alpha particle energy spectra of uraniferous rocks and minerals. "Infinitely thick" sources were used to avoid the problems involved in preparation of "infinitely thin" sources. The problem of generating theoretical energy distributions for infinitely thick sources was solved. Complete theoretical spectra were computed for comparison with experimentally obtained alpha particle energy spectra of rocks and minerals. The presence and extent of disequilibrium in the ^{238}U decay series in a rock are determined from the residual spectrum obtained by subtracting a fitted theoretical spectrum from the measured spectrum of a rock. (Diss. Abstr. Int., B)

55768 INDIRECT METHODS USED AT CNEN FOR THE EVALUATION OF INTERNAL CONTAMINATION. Testa, C. (CNEN, Rome). pp 405-21 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The paper describes the radiotoxicological analyses used at the CNEN nuclear centers. The different techniques for the determination of α-, β- and γ-emitters in biological samples are briefly given, e.g., the determination of ^{210}Po, ^{226}Ra, natural thorium, enriched uranium, plutonium, gross alpha activity, ^{90}Sr, gross beta activity, and gamma emitters in samples of urine, nose blows, and feces. Original methods are used for the rapid isolation of natural thorium, enriched uranium, plutonium, and ^{90}Sr from urine by means of reversed-phase chromatographic techniques with Microthene-710 (microporous polyethylene) in powder form supporting some selective extractants. Special chromatographic columns and batch-extraction processes are used to shorten the mineralization and the isolation procedure. A Microthene-TOPO (tri-n-octylphosphine oxide) slurry is used to extract uranium, thorium, and plutonium from urine that has been wet-mineralized with nitric acid; suitable eluting agents are then used to strip the particular radionuclide. A Microthene-HDEHP, di-(2-ethylhexyl)orthophosphoric acid, slurry is used for the selective extraction of ^{90}Y from the urine at pH 5: ^{90}Sr in equilibrium can then be calculated. All these methods are simple, selective and rapid; the chemical recoveries range from 70 to 90%, with acceptable blanks; the chemical yields were confirmed also with metabolized ions by using urine from rats injected with the radionuclides. Some examples of slight internal contamination are also reported. (auth)

55769 ELECTROLYTIC CHROMATOGRAPHY AND COULOMETRIC DETECTION WITH THE COLUMN ELECTRODE. Fujinaga, T. (Kyoto Univ.). Pure Appl. Chem.; 25: No. 4, 709-26 (1971).

A very rapid electrolytic analysis termed "electrolytic chromatography," using a column electrode with glassy carbon grains, was developed. The column electrode was used not only for coulometric detection, but also for separation of metals, elimination of interfering elements, unification of oxidation state, and concentration of an element. Some analytical applications of electrolytic chromatography are introduced especially with radioactive nuclides including radiometric determination of ^{212}Pb, ^{212}Bi, and ^{212}Po and determination of plutonium in the presence of U, Fe, and Cr. Down to 1.0 μl of a 10^{-2}M or 1000 ml of a 10^{-8}M solution can be analyzed with satisfactory accuracy. (auth)

55770 DETERMINATION OF ^{210}Po. de Boeck, R. Ghent; Ghent Rijksuniversiteit (1970). 112p. (In Dutch).

Thesis.

Procedures for the quantitative determination of ^{210}Po in lead and in urine were developed. The ^{210}Po isotope was separated quantitatively and selectively from the matrixes by solvent extraction steps and by spontaneous deposition on an Ag foil prior to counting. For determination of natural ^{210}Po in lead two methods, the first based on cupferron-dithizon extraction and the second on N-benzoyl N-phenyl-hydroxylamine (BPHA) extraction, were used to isolate the isotope from the solution of lead and its impurities. The influence of minor constituents on the cupferron and BPHA extraction and their coextraction was controlled. Optimum conditions for spontaneous deposition on Ag were investigated experimentally. The method for determination of ^{210}Po in urine includes wet ashing of the samples with concentrated HNO_3 and $HClO_4$, extraction of ^{210}Po from the remaining solution with BPHA in $CHCl_3$ and a back-extraction from the organic phase with 1 N HCl. (auth) (Belgium)

Separation Procedures

Refer also to abstracts 57225, 57226, and 58077.

55771 QUANTITATIVE TREATMENT OF THE DISTRIBUTION COEFFICIENT FOR COPRECIPITATION OF METAL OXALATES. Munakata, Megumu (Kinki Univ., Osaka); Toyomasu, Shigeki; Shigematsu, Tsunenobu. Anal. Chem.; 44: No. 12, 2057-60(Oct 1972).

The distribution coefficient, λ, of coprecipitation in binary metal oxalates, calcium—strontium, calcium—rare earth and rare earth—rare earth, is discussed as based on precipitation rate and solubility products. In the calcium—rare earth systems, the coefficients equal the ratio of the apparent rate constants for the precipitation. The distribution coefficient in the calcium—strontium oxalate system was determined by the ratio of the solubility products rather than the rate constants. Neither the solubility product nor precipitation rate, however, was correlated to the distribution coefficient of the coprecipitation for rare earth—rare earth oxalate systems. (auth)

55772 RESEARCH ON OBTAINING HAFNIUM OF NUCLEAR PURITY. I. Popa, Lucretia I.; Arsenie, Ioana (Inst. of Atomic Physics, Bucharest). Rev. Roum. Chim.; 17: No. 5, 937-44(May 1972). (In French).

Results are presented on the separation of hafnium and zirconium using anion exchange resins in a sulfate medium. Zirconium forms stable complexes in the range 1.4 to 2.5N sulfuric acid; under the same conditions of acidity, zirconium forms less stable complexes, the value of Kd(Zr) being greater than Kd(Hf) (20 to 22%). The separation coefficients showed a small decrease with increase in the concentration of sulfuric acid. Hafnium is obtained in the first fractions eluted by 1.5 to 5N sulfuric acid only after zirconium; with elution by 10N sulfuric acid, zirconium appears in the first fractions, hafnium being obtained in the first fractions eluted. (E.J.H.)

55773 EXTRACTION OF THORIUM HYDROXYTHIOCYANATE WITH TRIBUTYL PHOSPHATE. Klyuchnikov, V. M.; Zaitsev, L. M.; Apraksin, I. A. Zh. Neorg. Khim.; 17: No. 8, 2274-7 (Aug 1972). (In Russian).

Extraction of Th hydroxythiocyanate from aqueous solutions by TBP was conducted with volume organic/volume water = 1, where the aqueous solution originally contained ammonium thiocyanate and thorium nitrate of various concentrations. Preliminary tests showed that a high hydroxyl number, $OH^-/Th = 2.8$ was desirable for optimum extraction at 20°C in the 20-min extraction period. The extraction of Th hydroxythiocyanates (for example, $Th(OH)_{2.1}(CNS)_{1.9}$) with TBP from aqueous solutions resulted from the formation of complexes of polynuclear compounds with the extracting agent. (K.S.W.)

55774 EXTRACTION OF POLYNUCLEAR THORIUM HYDROXYNITRATE BY TRIBUTYL PHOSPHATE. Klyucnikov, V. M.; Zaitsev, L. M.; Apraksin, I. A. Zh. Neorg. Khim.; 17: No. 8, 2269-73(Aug 1972). (In Russian).

Thorium hydroxynitrate was extracted from aqueous solution by means of TBP as a result of the complex $[Th_4(OH)_{10}(NO_3)_6 \cdot 4TBP]$ with Th having a coordination number of nine and a Th/TBP ratio of unity. This complex is characterized by weaker Th—O bonds in the Th—TBP portion of the complex than is the case with the complex $Th(NO_3)_4 \cdot 2TBP$. Chemical analyses and ir spectra failed to detect other compositions of Th hydroxynitrate in the extracts. (K.S.W.)

55775 USE OF TRI-N-BUTYL PHOSPHATE FOR CONCENTRATING ADMIXTURES IN THE ANALYSIS OF BISMUTH. Biryukova, E. Ya.; Razumova, L. S.; Goryushina, V. G. (State Scientific-Research and Planning Inst. of the Rare-Metals Industry, Moscow). Zh. Anal. Khim.; 27: No. 6, 1207-8(Jun 1972). (In Russian).

A method of group concentration of admixtures based on removing bismuth by the extraction with tributyl phosphate from 1 N HCl is suggested. The extraction procedure can be carried out in separatory funnels or on a chromatographic column depending on the completeness of the bismuth extraction needed. The method permits the concentration of copper, cobalt, nickel, manganese, lead, chromium, aluminum, alkali, alkaline earths, rare earths, and other elements. (auth)

55776 SYNERGIC EXTRACTION OF AMERICIUM(III) AND EUROPIUM(III) BY A QUATERNARY AMINE AND ORGANOPHOSPHOROUS EXTRACTANTS FROM THIOCYANATE SOLUTIONS. Khopkar, P. K.; Narayanankutty, P. (Bhabha Atomic Research Centre, Bombay). J. Inorg. Nucl. Chem.; 34: No. 10, 3233-41(Oct 1972).

Extraction of Am(III) and EU(III) from 1M NH_4 SCN by mixtures of the thiocyanate form of Aliquat-336-S and three neutral organophosphorous extractants TOPO, TBPO, and TBP in xylene was investigated. Moderate synergic effects were obtained which are ascribed to the extraction of mixed metal complexes whose composition was determined. Probable reasons for the observed synergic effects are discussed. (auth)

55777 PUBLICATIONS ON EXTRACTION OF INORGANIC COMPOUNDS (A REVIEW). Bagreev, V. V.; Zolotov, Yu. A.; Kurilina, N. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 27: No. 6, 1161-5(Jun 1972). (In Russian).

Literature published before 1968 on different problems of extraction of inorganic species (9385 publications) was analyzed from the point of view of developing extraction as a scientific discipline. Data are given on the numbers of publications (percentages) dedicated to separate elements, extraction reagents, and groups of extractable compounds. (auth)

55778 SEPARATION OF ZIRCONIUM FROM HAFNIUM BY SOLVENT EXTRACTION. de Oliveira Pavia, I. R.; Behmel, K. L.; Hainberger, L. (Pontifica Univ. Catolica, Rio de Janeiro). An. Acad. Brasil. Cienc.; 43: No. 3-4, 599-602(1971). (In Portuguese).

A study of the extraction of zirconium from hafnium using alamine 336 dissolved in n-heptane and chloroform is presented. (tr-auth)

55779 EXTRACTION OF ERBIUM THIOCYANATE BY TRIISOAMYLPHOSPHINE OXIDE. Mikhailichenko, A. I.; Yusupova, G. K. Zh. Neorg. Khim.; 17: No. 8, 2284-8(Aug 1972). (In Russian).

The extraction of erbium thiocyanate from an aqueous solution by triisoamylphosphine oxide TIAPO proceeds according to the equation: $Er^{3-}_{aq.} - 3(SCN)^{-}_{aq.} - 3\ TIAPO_{org.} \rightleftharpoons [Er(SCN)_3 \cdot 3TIAPO]_{org.}$. In the extracted complex erbium is coordinated with three N atoms and three O atoms of the phosphine compound, and possesses a coordination number of six. The complex does not contain hydrated water molecules. (K.S.W.)

55780 SYNTHESIS AND ION EXCHANGE PROPERTIES OF THERMALLY STABLE TITANIUM(IV) VANADATE: SEPARATION OF Sr^{2+} FROM Ca^{2+}, Ba^{2+}, AND Mg^{2+}. Qureshi, Moshin; Varshney, K. G.; Kabiruddin, S. K. (Aligarh Muslin Univ., India). Can. J. Chem.; 50: No. 13, 2071-8(1 Jul 1972).

A new, thermally stable, and highly strontium-specific inorganic ion exchanger, titanium(IV) vanadate, was prepared by mixing 0.5 M solution of titanic chloride and sodium vanadate at pH 0–1. Its ion exchange capacity is 0.65 mequiv./g at 400°C. Separation factors of Sr^{2+} with respect to Ba^{2+}, Ca^{2+}, and Mg^{2+} are 8, 11.8, and 33.3, respectively. Binary mixtures of Sr^{2+} with Ba^{2+}, Ca^{2+}, and Mg^{2+} were separated. Calcium and magnesium are eluted with 0.001 M HNO_3. Barium and strontium are eluted with 0.01 and 0.1 M HNO_3, respectively. A new parameter $\Delta C/\Delta T$ is proposed for the study of structural changes in inorganic ion exchangers. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physico-chemical Properties

Refer also to abstracts 55687, 55902, 55906, 55909, 55913, 55927, 55939, 56230, and 57931.

55781 STUDY OF THE $\beta \rightarrow \alpha$ PHASE TRANSITION IN $UO_2(OH)_2$ BY DILATOMETRIC, MICROCALORIMETRIC, AND X-RAY DIFFRACTION TECHNIQUES. Taylor, J. C.; Kelly, J. W.; Downer, B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Solid State Chem.; 5: No. 2, 291-9(Sep 1972).

When $\beta-UO_2(OH)_2$ is cooled to about 5°C, it transforms rapidly into $\alpha-UO_2(OH)_2$ with a volume change $\Delta V/V$ of –14.7%. The volume change was measured by dilatometry. The enthalpy change accompanying the transformation was measured by a specially constructed microcalorimeter, and found to be 1.36 ± 0.22 kcal/mole. The temperature of the transition was 5.1 ± 2.3°C. The fraction of $\beta-UO_2(OH)_2$ converted to $\alpha-UO_2(OH)_2$ in each run was determined both by direct weighing and x-ray diffraction methods. The transformation is unusual for a nonmetallic crystal in that it is analogous to the martensitic transformations common in metals and alloys. On the basis of the known structures of the α and β phases, and morphological changes accompanying the transition, a mechanism for the transformation is proposed, and it is suggested that hydrogen bonds are probably not broken during the transformation. (auth)

55782 DEACTIVATION PROCESSES IN THE INDUCED CONDENSATION OF ARSENOLITH. Becker, K. A.; Grosse, G. (Max-Planck-Gesellschaft, Berlin). Z. Phys. Chem. (Frankfurt); 79: No. 5-6, 269-77(Jul 1972). (In German).

With the help of γ radiation from ^{76}As, the layer thickness distribution of an induced arsenic condensate was determined. The deactivation processes of the excited molecules can also be concluded from these processes. It is shown that, for low vapor pressures (about 10^{-3} Torr), the deactivation proceeds on an equilibrium between preactivated and critically activated particles. (tr-auth)

55783 SEPARATION AND CHARACTERIZATION OF RUTHENIUM HYDROLYZATES BY GEL-PERMEATION CHROMATOGRAPHY. Kitayevitch, I.; Rona, M.; Schmuckler, G. (Technion–Israel Inst. of Tech., Haifa). Anal. Chim. Acta; 61: No. 2, 277-83(Sep 1972).

Ruthenium nitrosyl nitrate hydrolyzes in nitric acid solutions and forms two fractions, a monomeric and a polymeric one. These fractions can be separated on Sephadex gels, the existence of the polymeric fraction being proved by ultracentrifuge experiments. Ultraviolet and visible spectra of the two fractions show no difference in the absorbance patterns in a given concentration of nitric acid. Atomic absorption, however, indicated the lower state of atomization of the polymeric fraction and consequently produced lower signals than the monomeric fraction. (auth)

55784 SOME MIXED COMPLEXES OF LANTHANIDE IONS. Shetty, S. Y. (Bhabha Atomic Research Centre, Trombay, India). Curr. Sci. (India); 41: No. 18, 675-7(20 Sep 1972).

Potentiometric studies were made of rare earth complexes with EDTA or HEDTA using oxine or β-isopropyltropolone. Stability constants were determined also. (M.C.G.)

55785 PREPARATION OF A NEW INORGANIC ION EXCHANGER: ZIRCONIUM–TITANIUM PHOSPHATE (ZTP). Marei, S. A.; Shakshooki, S. K. (Univ. of Libya, Tripoli). Radiochem. Radioanal. Lett.; 11: No. 3-4, 187-91(15 Sep 1972).

An inorganic ion exchanger was prepared by the addition of 12% phosphoric acid in 4M hydrochloric acid to an equimolar mixture of $TiCl_4$ and $ZrOCl_2 \cdot 8H_2O$ in 4M hydrochloric acid solution. The analysis shows that the ratio of (Zr + Ti) : PO_4 in the exchanger is 1 : 1. The behavior of this exchanger was tested with both Mn^{2+} and Fe^{3+} ions. (auth)

Isotope Effects

Refer also to abstract 55840.

55786 SUBMILLIMETER MICROWAVE SPECTRUM OF $H_2{}^{18}O$. De Lucia, Frank C.; Helminger, Paul; Cook, Robert L.; Gordy, Walter (Duke Univ., Durham, N. C.). Phys. Rev., A; 6: No. 4, 1324-6(Oct 1972).

The rotational spectrum of $H_2{}^{18}O$ in the ground vibrational state was investigated by means of high-resolution microwave spectroscopy. Ten new rotational transitions in the 1.0- to 0.4-mm wavelength region are reported. Among these are several low-J lines that are of significance in the atmospheric absorption of electromagnetic radiation in the microwave region. The frequencies of newly observed transitions are (in MHz): $5_{1,5} \leftarrow 4_{2,2}$, 322,465.17; $4_{1,4} \leftarrow 3_{2,1}$, 390,607.76; $4_{2,3} \leftarrow 3_{3,0}$, 489,054.26; $6_{2,4} \leftarrow 7_{1,7}$, 517,181.96; $6_{4,3} \leftarrow 5_{5,0}$, 520,137.32; $5_{3,3} \leftarrow 4_{4,0}$, 537,337.57; $1_{1,0} \leftarrow 1_{0,1}$, 547,676.44; $6_{4,2} \leftarrow 5_{5,1}$, 554,859.87; $5_{3,2} \leftarrow 4_{4,1}$, 692,079.14; and $2_{1,1} \leftarrow 2_{0,2}$, 745,320.20. Assignments were based on a weighted analysis of combined microwave and infrared data. (auth)

55787 LASER SPECTROSCOPIC MEASUREMENT OF THE ^{87}Rb–^{85}Rb D_1-LINE ISOTOPE SHIFT. Gibbs, Hyatt M.; Churchill, George C. (Bell Telephone Labs., Murray Hill, N. J.). J. Opt. Soc. Amer.; 62: No. 10, 1130-3(Oct 1972).

High-resolution (few MHz) absorption spectroscopy was demonstrated by using an atomic beam and a laser. The Doppler absorption width of natural-abundance Rb was reduced from ≈570 to 15 MHz (5.7-MHz natural width) by using an atomic beam. A magnetic field of about 75 kOe was used to scan the six ^{85}Rb and four ^{87}Rb m_I components of the D_1 line ($5^2S_{½}$ to $5^2P_{½}$; 7947.64 Å in zero field) into coincidence with the 7944.66-Å 1-μs ^{202}Hg II laser pulses. From the known ground- and excited-state hyperfine constants and the Breit–Rabi formula, it was concluded that the ^{87}Rb absorption spectrum is shifted up by 77 ± 3 MHz relative to that of ^{85}Rb. This uncorrected isotope shift can be compared with previous measurements of 105 ± 15 and 77.7 ± 2.1 MHz. Improved stability and a narrower atomic beam would permit reduction of the isotope shift and hyperfine constant errors to below 1 MHz. (auth)

55788 SECONDARY β AND γ DEUTERIUM ISOTOPE EFFECTS IN THE SOLVOLYSES OF ISOBUTYRYL AND PIVALOYL CHLORIDES. Effio Leon, Adan A. (East Lansing, Mich.; Michigan State Univ. (1972)). 77p. University Microfilms Order No. 72-22,211.

Thesis.

In order to assess the usefulness of secondary deuterium isotope effects as mechanistic criteria and to understand better the mechanism of solvolysis of aliphatic acid chlorides, the solvolysis of isobutyryl chloride and pivaloyl chloride was studied. The rates of solvolysis of isobutyryl chloride were determined over a temperature range from –29.120° to –4.987°C and acetone–water concentrations of 75% to 95%. Those of pivaloyl chloride were studied at temperatures from –14.132° to +4.001° and acetone-water concentrations of 75% to 90%. The β isotope effects in the solvolysis of isobutyryl chloride decreased as the water concentration and temperature decreased, e.g., $k_H/k_D(-24.985°) = 0.986 \pm 0.003$ (75), 0.956 ± 0.006 (90%); k_H/k_D (90%) $= 0.955 \pm 0.007$ (–29.120°), 0.987 ± 0.008 (–4.987°).

The γ isotope effect was nearly temperature independent, e.g., k_H/k_D (85%) = 0.964 ± 0.006 (−29.120°), 0.971 ± 0.0120 (−10.109°). k_H/k_D (95%) = 0.999 ± 0.022 (−19.793°), 0.994 ± 0.004 (−4.987°). It increased with decreasing polarity of the solvent, e.g., k_H/k_D (−15.616°) = 0.942 ± 0.008 (80%), 0.999 ± 0.003 (95%). The γ isotope effect in the solvolysis of pivaloyl chloride followed the same trend; it was temperature independent and increased as the polarity of the solvent decreased, e.g., k_H/k_D (−9.344°) = 0.909 ± 0.004 (75%), 0.962 ± 0.006 (90%); k_H/k_D (85%) = 0.943 ± 0.004 (−14.312°), 0.938 ± 0.004 (+4.001°). (TSS)

55789 INFRARED, RAMAN, AND PROTON RESONANCE SPECTRA OF TETRAMETHYLUREA, DIMETHYLUREA, AND N,N-DEUTERATED DIMETHYLUREA. Venkata Ramiah, K.; Murthy, M. Rama Krishna (Osmania Univ., Hyderabad, India). Curr. Sci. (India); 41: No. 18, 672-4(20 Sep 1972).

Spectra are shown and results indicate that the stretching frequencies for N−H are in the region of 3340 cm^{-1} and 3160 cm^{-1} while the corresponding N−D stretching frequencies are at 2470 cm^{-1} and 2430 cm^{-1}. (M.C.G.)

55790 MATRIX INFRARED SPECTRA AND BONDING IN THE DI- AND TRIIODOMETHYL RADICALS. Smith, David W.; Andrews, Lester (Univ. of Virginia, Charlottesville). J. Phys. Chem.; 76: No. 19, 2718-26(14 Sep 1972).

The codeposition of either CHI_3 or CI_4 at high dilution in argon with ^6Li or ^7Li produced new infrared absorptions which are attributed to LiI and the CHI_2 or CI_3 free radicals, respectively. The identity of the CHI_2 radical is confirmed by the reactions of CDI_3 with Li and CHI_3 with Na atoms. Assignments are made to the antisymmetric H−C−I valence angle bend and to the antisymmetric carbon−iodine stretch of CHI_2. The pyrolysis of CI_4 also produced CI_3; an assignment is made to the antisymmetric carbon−iodine stretch. The high values of $F_r - F_{rr}$ in CHI_2 (2.54 ± 0.03 mdyn/Å) and CI_3 (2.13 mdyn/Å) indicate considerable π bonding in the CHI_2 and CI_3 free radicals. (auth)

55791 FAR-ULTRAVIOLET SOLVENT SPECTROSCOPY. Fox, M. F.; Hayon, E. (Army Natick Labs., Mass.). J. Phys. Chem.; 76: No. 19, 2703-6(14 Sep 1972).

A systematic study of the far-ultraviolet spectroscopy of some polar liquid solvents has been carried out with the object of extending the range at which the spectroscopy of certain solutes can be determined. The solvents examined include water, D_2O, methyl alcohol, CH_3OD, CD_3OD, methyl cyanide, ethyl cyanide, n-propyl cyanide, trifluoroethyl alcohol, hexafluoro-2-propyl alcohol, dimethoxyethane, and acetone. The effect of temperature on the absorption spectra of these solvents was examined. A considerable blue shift was found for most solvents with decrease in temperature. The most significant temperature effects were found for hydroxylic solvents. Absorption spectra at different temperatures are given, and the transmission limits of the above solvents down to 60,500 cm^{-1} (~165 nm) have been tabulated. (auth)

55792 QUENCHING OF $^3P_1$ MERCURY ATOMS BY ISOTOPIC AROMATIC MOLECULES. Mains, Gilbert J.; Trachtman, Mendel (Philadelphia Coll. of Textiles and Science). J. Phys. Chem.; 76: No. 19, 2665-7(14 Sep 1972).

Quenching data are reported for benzene, nine deuterium-substituted benzenes, and three deuterium-substituted toluenes. Attempts to correlate the observed square of collision diameter for the quenching process, σ^2, in terms of simple C−H and C−D bonds and in terms of CH−CH, CH−CD, and CD−CD pairs were unsuccessful. The data were shown to be consistent with a previously proposed mechanism involving exciplex formation and intersystem crossing. An interpretation involving $^3P_0$ Hg atoms could not be ruled out but was considered unlikely. (auth)

55793 KINETIC HYDROGEN ISOTOPE EFFECT IN THE FLUORINATION OF H_2,CH_4, AND $CHCl_3$. Foon, R.; Reid, G. P.; Tait, K. B. (Univ. of New South Wales, Kensington, Australia). J. Chem. Soc., Faraday Trans., I; 68: No. 6, 1131-8(Sep 1972).

Kinetic isotope effects for the hydrogen abstraction reactions of fluorine atoms with H_2, CH_4, and $CHCl_3$ were measured by indirect competitive methods. The relative rate constants are given by $k(CHCl_3)/k(CDCl_3) = 0.81 \pm 0.25 \exp[(620 \pm 50)/RT]$, $k(H_2)/k(D_2) = 1.5 \pm 0.4 \exp[(130 \pm 300)/RT]$, $k(CH_4)/k(CD_4) = 1.0 \pm 0.3 \exp[(230 \pm 200)/RT]$. The result of $k(H_2)/k(D_2)$ agrees with that previously measured. These relatively small kinetic isotope effects are compared with rate parameters calculated from activated complex theory and classical trajectory analysis. Hydrogen atom transfer by quantum mechanical tunnelling is apparently unimportant. (auth)

55794 INTRA- AND INTER-MOLECULAR CATALYSIS AND HYDROGEN ISOTOPE EFFECTS IN THE IODINATION OF o- AND p-CARBOXYACETOPHENONE. Bell, R. P.; Cox, B. G.; Henshall, J. B. (Univ. of Stirling, Eng.). J. Chem. Soc., Perkin Trans., II; No. 9, 1232-7(1972).

Measurements were made of the rate of iodination of o- and p-carboxyacetophenone and their deuterated analogues. These reactions are of zero order with respect to iodine, the measured rate representing the rate of ionization of the acetyl group. In self-buffered solutions of the ortho-compound the rate can be attributed solely to intramolecular proton transfer from the acetyl to the carboxylate group. In acetate and pyridine buffers there is also a contribution from intermolecular proton transfer to acetate ion or pyridine, and this is the only type of process detectable for the para-compound. The kinetic hydrogen isotope effect for the intramolecular process (k^H/k^D = 5.4) is considerably greater than that for any of the intermolecular processes (k^H/k^D = 4.0). A study was also made of the catalytic effect of the anions of the carboxyacetophenones in the decomposition of nitramide and the mutarotation of glucose. This leads to an estimate of the "true" acid−base properties of the carboxy group in o-carboxyacetophenone, and hence to a quantitative comparison between intra- and intermolecular catalysis: it also shows that in aqueous solution 81% of the undissociated acid exists as the cyclic tautomer. (auth)

55795 STUDIES IN SOLVOLYSIS. PART IV. SUBSTITUENT AND SOLVENT ISOTOPE EFFECTS IN THE SOLVOLYSIS OF A SERIES OF BENZYL TRIFLUOROACETATES. Winter, June G.; Scott, J. M. W. (Memorial Univ., St. John's Newfoundland). Can. J. Chem.; 50: No. 12, 1886-90(15 Jun 1972).

The rates of neutral hydrolysis of a series of 4-substituted benzyl trifluoroacetates $4\text{-}X\text{-}C_6H_4CH_2OCOCF_3$, X = NO_2, Cl, H, CH_3, and OCH_3 were studied in water and deuterium oxide, both solvents containing 0.012 mol fraction of acetone. The alteration of the rates with the nature of the 4-substituent and the kinetic solvent isotope effect ($k(H_2O)/k(D_2O)$) are consistent with the proposal that the esters with X = NO_2, Cl, H, and CH_3 all react by an acyl−oxygen $B_{Ac}2$ mechanism. On the other hand, the same mechanistic criteria indicate that the 4-methoxybenzyl ester reacts by both the $B_{Ac}2$ and the S_N1 alkyl−oxygen fission paths in equal amounts. (auth) (Canada)

55796 STUDIES IN SOLVOLYSIS. PART V. FURTHER INVESTIGATIONS CONCERNING THE SOLVOLYSIS OF PRIMARY, SECONDARY, AND TERTIARY TRIFLUOROACETATES. Barnes, D. J.; Cole, M.; Lobo, S.; Winter, J. G.; Scott, J. M. W. (Memorial Univ. of Newfoundland, St. John's). Can. J. Chem.; 50: No. 14, 2175-81(15 Jul 1972).

The rate of solvolysis of ethyl trifluoroacetate was investigated in a series of H_2O/D_2O mixtures at 9.97°C. The secondary isotope effects related to the hydrolysis of the isotopic pairs, methyl/methyl-d_3, ethyl/ethyl-d_5, i-propyl/i-propyl-β-d_6 and t-butyl/t-butyl-d_9 trifluoroacetates were established as well as the temperature dependence for the hydrolysis of t-butyl trifluoroacetate. The significance of all these measurements with respect to the mechanism of these reactions is discussed. (auth) (Canada)

55797 SPECTRA OF H_2–Ne AND D_2–Ne VAN DER WAALS COMPLEXES IN THE COLLISION-INDUCED FUNDAMENTAL BANDS OF HYDROGEN AND DEUTERIUM. McKellar, A. R. W.; Welsh, H. L. (Univ. of Toronto). Can. J. Phys.; 50: No. 13, 1458-64(1 Jul 1972).

Spectra of H_2−Ne and D_2−Ne Van der Waals complexes accompanying transitions in the collision-induced fundamental bands of hydrogen and deuterium were obtained with an absorption path of 110 m at temperatures around 27 K in a specially designed multiple-traversal cell. The observed structure is similar to that of H_2− and D_2 − Ar, Kr, and Xe complexes studied earlier, but the number of lines observed for the Ne complexes is fewer because of the shallower intermolecular potential. Well-resolved R and P branches ($\Delta l = \pm 1$, where l is the rotational quantum number of the complex) accompanying the overlap-induced Q_1 (0) transitions are analyzed directly to give rotational (B) and centrifugal stretching (D) constants for the complexes. Unlike the other H_2−rare gas complexes the spectra accompanying quadrupole-induced transitions show no direct evidence of anisotropy of the intermolecular forces. (auth) (Canada)

55798 KINETIC AND MECHANISTIC STUDIES ON THE ACID-CATALYZED DEBROMINATION OF α-BROMOACETOPHENONES AND α-BROMOPROPIOPHENONES WITH TRIPHENYLPHOSPHINE IN ETHANOL. Borowitz, Irving J.; Parnes, Howard; Lord, Eric; Yee, Kwok Chun (Yeshiva Univ., New York). J. Amer. Chem. Soc.; 94: No. 19, 6817-22(20 Sep 1972).

The debromination of phenyl-substituted α-bromopropiophenones or α-bromoacetophenones to give the corresponding ketone occurs with triphenylphosphine in ethanol (or with ethanol-nonpolar solvent mixtures) and is both acid and alcohol catalyzed. The reactions follow second-order overall rates and give "U" shaped ρ plots. These ρ plots can be separated into ethanol-catalyzed lines with positive slopes and curved acid-catalyzed plots with negative slopes. Data are presented which suggest that the acid catalysis is general. Solvent deuterium isotope effects (k_2^H/k_2^D) of 0.89 to 1.61 are found under various reaction conditions. The relative rates of debromination of α-bromoacetophenone : α-bromopropiophenone : α-bromoisobutyrophenone are 45 : 1.4 : 1.0. The accumulated data suggest mechanistic pathways involving attack of triphenylphosphine on bromine of acid or ethanol coordinated bromo ketones. (auth)

55799 SUBSTITUENT EFFECTS ON AMIDE HYDROGEN EXCHANGE RATES IN AQUEOUS SOLUTION. Molday, Robert S.; Kallen, Roland G. (Univ. of Pennsylvania, Philadelphia). J. Amer. Chem. Soc.; 94: No. 19, 6739-45(20 Sep 1972).

Hydronium and hydroxide ion catalyzed amide hydrogen exchange rate constants were measured for a series of acyl-substituted amides and several related compounds. Substituents which exert electron-withdrawing polar effects were found to increase the hydroxide ion rate constant (k_{OH}) by more than 10^3 ($\rho^I = +0.87$) and to decrease the hydronium ion (k_H) catalyzed rate constant, for a more limited series, by greater than tenfold. The relatively marked sensitivity of k_H values to polar effects favors an exchange mechanism which involves N-protonation rather than kinetically indistinguishable mechanisms which involve initial O-protonation of the amide. Substituent effects on amide hydrogen exchange rates are interpreted in terms of alterations in pK values for proton dissociation from neutral amides (pK_{N_2}) for the base-catalyzed pathway and from N-protonated amides (pK_{N_1}) for the acid-catalyzed path. From the rate constants (k_H and k_{OH}), the respective values of pK_{N_1} and pK_{N_2} for N-methylacetamide are computed at −7.8 and 17.7. The tautomerization constant for O−N protonation of cationic N-methylacetamide is 10^7. The k_H value for N-methylurea is about 10^4 greater than that for N-methylacetamide due to a much higher nitrogen basicity for N-methylurea. The kinetic isotope effect between CONH and COND is less than 15% for both hydronium and hydroxide ion catalyzed exchange pathways. (auth)

55800 MIXED SOLVENT DEUTERIUM ISOTOPE EFFECTS ON THE HYDROLYSIS OF $UO_2{}^{2+}$ AND Be^{2+} IONS. Maeda, Masunobu (Tokyo Inst. of Tech.); Amaya, Toshihiko; Ohtaki, Hitoshi; Kakihana, Hidetake. Bull. Chem. Soc. Jap.; 45: No. 8, 2464-8 (Aug 1972).

Stability constants of the hydrolysis species from UO_2^{2+} were determined in pure light water and 80% heavy water containing 3 M $NaClO_4$ as an ionic medium at 25°C, and the results were compared with those in pure heavy water. The decrease of the stability constants in hydrolysis reactions of the UO_2^{2+} ion, as well as of the Be^{2+} ion, is discussed in terms of the equilibrium theory of the solvent deuterium isotope effects, which is based on the assumptions that activity coefficients of chemical species in isotopic exchange equilibria remain unchanged with the change in the deuterium atom fraction in the solvent, that the solvated hydrogen ion possesses three equivalent lyons, and that the isotopic equilibria are subject to the rule of the simple geometric mean. Satisfactory agreements were found between the observed and calculated values for relative stability constants of the hydrolysis species of UO_2^{2+} and Be^{2+} in water of various hydrogen isotopic compositions. (auth)

55801 VIBRATIONAL SPECTRA OF PROPIONAMIDE AND ITS C- AND N-DEUTERATED COMPOUNDS. Kuroda, Yoshihiro; Saito, Yutaka; Machida, Katsunosuke; Uno, Toyozo (Kyoto Univ.). Bull. Chem. Soc. Jap.; 45: No. 8, 2371-83(Aug 1972).

The infrared and Raman spectra of $CH_3CH_2CONH_2$, $CH_3CD_2CONH_2$, and their N-deuterated compounds in the solid state were measured. The normal coordinate analysis was made by assuming the molecular symmetry of C_s. A Urey-Bradley force field was used for the in-plane vibrations and a valence force field for the out-of-plane vibrations of the amide group. The ethyl group was treated by a Urey-Bradley type force field as well as a valence-type force field. Assignments of the fundamental frequencies were made by referring to the infrared and Raman intensities, isotopic frequency shift, and the calculated frequencies by using the force constants taken from n-paraffins and acetamide. The agreement between observed and the calculated frequencies in the initial calculation was good for the CH_3 and the amide group vibrations but was not good enough for some vibrations involving the α-carbon atom. Only the force constants related to these vibrations were refined by the least squares method in order to obtain the best fit. The frequencies calculated in this way fit the observed ones satisfactorily. (auth)

55802 VIBRATIONAL SPECTRA OF TRANS-TRANS DIACETAMIDE AND ITS C- AND N-DEUTERATED COMPOUNDS. Kuroda, Yoshihiro; Saito, Yutaka; Machida, Katsunosuke; Uno, Toyozo (Kyoto Univ.). Bull. Chem. Soc. Jap.; 45: No. 8, 2413-23(Aug 1972).

The infrared spectra of $CH_3CONHCOCH_3$, $CD_3CONHCOCH_3$, $CD_3CONHCOCD_3$, and their N-deuterated compounds were recorded for the unstable crystalline modification in which the molecules are in the trans-trans conformation (form B). The Raman spectra of $CH_3CONHCOCH_3$ in the form B crystal and in the complex with KI were also recorded. Vibrational assignments are given by referring to the characteristic group frequencies of related compounds, the infrared dichroic measurement for $CH_3CONHCOCH_3$, and the isotopic frequency shifts. The normal coordinates analysis was made by assuming the plane trans-trans conformation of the −CONHCO− (−CONDCO−) group. The calculated frequencies fit to the observed satisfactorily. (auth)

55803 ^{14}C ISOTOPE EFFECT ON sp^2–sp^3 HYBRIDIZATION IN THE PROTOTROPIC EQUILIBRIUM OF N-BENZYLIDENEBENZYLAMINE. Yukawa, Yasuhide; Ando, Takashi; Otsubo, Tetsuo (Osaka Univ.). Bull. Chem. Soc. Jap.; 45: No. 8, 2645-6(Aug 1972).

N-Benzylidenebenzylamine, labeled with ^{14}C, was prepared and equilibrium effected by the action of 30 parts of 1.45 N alcoholic sodium ethoxide at 40.0 and 82.0°C. Equilibrium was reached within 36 hr at 40°C and 30 min at 82°C. Small isotope effects on the equilibrium were shown: $K = 0.983 \pm 0.002$ at 40.0°C and $K = 0.986 \pm 0.002$ at 8.20. The equilibrium was in favor of the ^{14}C at the sp^2-position. (M.C.G.)

55804 ISOTOPE EFFECT STUDIES ON ELIMINATION REACTIONS. VIII. THE MECHANISM OF THE 1,3-ELIMINATION REACTION OF 3-PHENYLPROPYLTRIMETHYLAMMONIUM IODIDE WITH AMIDE ION IN LIQUID AMMONIA. Westaway, K. C.; Bourns, A. N. (McMaster Univ., Hamilton, Ont.). Can. J. Chem.; 50: No. 14, 2332-43(15 Jul 1972).

Reaction of 3-phenylpropyltrimethylammonium iodide with potassium amide in liquid ammonia at −55°C was found to give concurrent 1,3-elimination forming phenylcyclopropane and 1,2-elimination forming 3-phenylpropene and cis- and trans-1-phenylpropene. Deuterium tracer studies on the salt labelled at C-3 established that neither a carbene nor an ylide are intermediates in the 1,3-elimination process. Isotopic exchange at C-3 was shown to accompany the reaction of the deuterated salt in ordinary ammonia, but it was not detected in the reaction of unlabelled salt in ammonia-d_3. A nitrogen isotope effect, k^{14}/k^{15}, of 1.022 ± 0.001 was found for the 1,3-elimination, while the corresponding hydrogen isotope effect, estimated from the effect of isotopic substitution on the 1,3- and 1,2-elimination ratio, was shown to exceed 20. The hydrogen isotope effect for the disappearance of undeuterated and deuterated salts (elimination and exchange) was approximately 7.4. These observations, as well as the influence of deuterium substitution in both the quaternary salt and the solvent on the relative rates of 1,3- and 1,2-elimination, were shown to be in accord with an Elcb mechanism in which the rate constants for the conversion of the intermediate 3-carbanion to 1,3-elimination product and for return to reactant by abstraction of a proton from ammonia are of the same order of magnitude. (auth) (Canada)

55805 NEW ELECTRONIC SPECTRA ATTRIBUTED TO LuH AND LuD. d'Incan, J.; Effantin, C.; Bacis, R. (Univ. Lyon, Villeubanne, France). J. Phys., B (London); 5: No. 9, L187-8 (Sep 1972). (In French).

In the spectral region lying between 4000 to 8000 Å new electronic systems were recorded; six of them are attributed to LuH and eight others to LuD. Preliminary molecular constants are given. (auth)

Isotope Exchange and Isotope Separation

55806 MICROWAVE SPECTROSCOPY ANALYSIS OF THE DISTRIBUTION OF DEUTERIUM IN PROPENE-d_1 OBTAINED FROM CATALYZED HYDROGEN–DEUTERIUM EXCHANGE REACTIONS. Scharpen, LeRoy H. (Hewlett-Packard Co., Palo Alto, Calif.); Rauskolb, Roger F.; Tolman, Chadwick A. Anal. Chem.; 44: No. 12, 2010-15(Oct 1972).

Five subspecies of propene-d_1, differing in the location of the deuterium atom, can be distinguished by microwave spectroscopy. Quantitative analysis of these subspecies by microwave spectroscopy was done for samples obtained by hydrogen–deuterium exchange between CH_3OD and propene-d_0 in the presence of homogeneous catalysts of Pt, Rh, and Ni. The relative amount of each subspecies in a sample varied considerably for the catalysts used. The relative standard deviation of the analytical result was about 2% of the values found for subspecies concentrations ranging from 1.5% to 17% of the total sample. Most spectrometer functions, including signal processing, were controlled by computer. (auth)

55807 EVIDENCE FOR THE COMPACT CONFORMATION OF MONOMERIC GLUCAGON. HYDROGEN–TRITIUM EXCHANGE STUDIES. McBride-Warren, Patricia A.; Epand, Richard M.

(Univ. of Guelph, Ontario). Biochemistry; 11: No. 19, 3571-5 (12 Sep 1972).

Glucagon, a polypeptide hormone of 29 amino acids, was subjected to tritium–hydrogen exchange according to the two-column technique of Englander. The primary structure of this molecule does not contain any covalent crosslinks such as peptide cyclization or disulfide bonds; thus any slowly exchanging hydrogens would indicate a folding of the peptide chain. The hydrogen exchange of glucagon is described by more than one first-order rate constant. The exchange of the slowest class of hydrogen exhibits specific acid and base catalysis and is composed of approximately 8 hydrogens. The number of hydrogens in this kinetic class was found to be nearly constant (±2 hydrogens) within the entire pH interval investigated, showing that no conformational change had occurred between pH 1.7 and 4.0. It is suggested that most of these slowly exchanging hydrogens result from i to (i + 3) hydrogen bonds of tetrapeptide β bends. (auth)

55808 EFFECT OF AMINES ON THE BISULFITE-CATALYZED HYDROGEN ISOTOPE EXCHANGE AT THE 5 POSITION OF URIDINE. Wataya, Yusuke; Hayatsu, Hikoya (Tokyo Univ.). Biochemistry; 11: No. 19, 3583-8(12 Sep 1972).

A method to label uracil derivatives at the 5 position was developed. When uridine 5′-phosphate was treated with a D_2O solution of 1 M ammonium sulfite at pD 9.2 and 37°C for 24 hr, 35% of the hydrogen at the 5 position of uracil was replaced by deuterium. pD 9 was optimal for this exchange to occur. Both ammonia and sulfite are required for this reaction, since neither sodium sulfite nor ammonium carbonate alone exhibited the catalytic effect. Kinetic studies showed that the rate of the hydrogen–deuterium exchange is linearly dependent on both bisulfite and amine concentrations. It was considered that the role of amine in this labeling reaction is to subtract hydrogen from the 5 position of the uridine–bisulfite adduct. It was also found that amines accelerate the rate of the reversible addition of bisulfite to uridine. The acceleration was noted both for the addition and the elimination, and the equilibrium was shifted to the adduct side by the presence of amines. The exchange reaction mechanism is discussed on the basis of these findings. Uridylyl-(3′-5′)-cytidine was labeled with tritium by treatment with T_2O in the presence of ammonium sulfite. When the labeling was carried out at pH 9.0, the uracil residue was preferentially labeled, whereas at pH 7.5 both the uracil and cytosine moieties were labeled. The mildness of the reaction conditions required for the labeling of uridine suggests applicability of the present method to polynucleotides. (auth)

55809 SEPARATION OF ^{140}Ba AND ^{140}La BY ISOTOPIC EXCHANGE USING IMPREGNATED PAPER CHROMATOGRAPHY. Borke, Mitchell L.; Liang, Nina Y. (Duquesne Univ., Pittsburgh). Anal. Chem.; 44: No. 12, 2080-1(Oct 1972).

Isotopic exchange coupled with thin layer chromatography was used for a simple and relatively rapid separation of carrier-free ^{140}La from its parent ^{140}Ba. By using an equilibrium mixture of ^{140}Ba and ^{140}La on barium sulfate impregnated filter paper and developing with dilute sulfuric acid–dioxane solvent system, ^{140}Ba was retained at the point of application while ^{140}La advanced upward almost to the solvent front, so that a clear separation was obtained. (J.G.B.)

55810 OXYGEN SPECIES ADSORBED ON OXIDES. 2. FORMATION OF $(O_3^-)_s$ ON MgO. Tench, A. J. (Atomic Energy Research Establishment, Harwell, Eng.). J. Chem. Soc., Faraday Trans., I; 68: No. 7, 1181-9(1972).

A MgO surface containing adsorbed $(O^-)_s^+$ ions reacts with excess oxygen to form the molecular ion $(O_3^-)_s$. This ion was characterized by ESR using oxygen enriched with ^{17}O and shows a complex hyperfine structure. Heating at 400°K converts the $(O_3^-)_s$ and an isotopic exchange occurs between the various oxygen nuclei. The optical data indicate that a band close to 420 nm is associated with the $(O_3^-)_s$ species. Calculations using electron affinity and bond energy data indicate that the reaction $O^- + O_2 \rightarrow O_3^-$ is exothermic and that $(O_3^-)_s$ must be considered as a possible adsorbed oxygen species on oxides. (auth)

55811 STUDIES ON THE ISOTOPIC EXCHANGE BETWEEN A MONOLAYER DEPOSITED ON NOBLE METAL SURFACES AND AQUEOUS SOLUTIONS. II. Toth, Geza; Miller, Janos. Magy. Kem. Foly.; 78: No. 6, 282-8(Jun 1972). (In Hungarian).

Isotopic exchange between iodine adsorbed on platinum, and iodide, iodine, and triiodide, respectively, was investigated. The isotopic exchange proceeds according to the empirical equation $\ln(1 - F) = b + a \ln t$, which can be derived from the McKay equation by taking into account the energetic nonuniformity of the platinum surface, i.e. the fact that the adsorption energy of iodine and consequently the activation energy of the exchange process, change with the logarithm of the number of surface sites according to the Freundlich isotherm. No rate-controlling effect due to diffusion in the aqueous phase was observed in parallel runs carried out with stirred and unstirred solutions. An analysis of the $\ln(1 - F)$ vs $\ln t$ functions suggests that the only form able to exchange is the I_3^- complex ion. (auth)

55812 ISOTOPIC EXCHANGE BETWEEN HYDROGEN AND WATER VAPOR OVER SUPPORTED METAL CATALYSTS. PART I. KINETICS OF THE EXCHANGE. Rolston, J. H.; Goodale, J. W. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 50: No. 12, 1900-6(15 Jun 1972). (AECL–4191).

Some rate data for the transfer of a deuterium atom tracer between hydrogen and water vapor, catalyzed by platinum supported on γ-alumina, are reported. Above 100°C the transfer rate measured at 1 atm total pressure is shown to be free of mass transfer effects, and obeys an initial first order dependence on water vapor for vapor pressures less than 10 torr. A near zero order of dependence was observed at higher water vapor pressures. At temperatures below 100°C the transfer rate was essentially independent of water vapor pressure between 5 and 100 torr suggesting that surface adsorbed water is involved in the rate limiting transfer step. (auth) (Canada)

55813 ACTIVATION OF HYDROGEN AT 78°K ON PARAMAGNETIC CENTERS OF MAGNESIUM OXIDE. Boudart, M.; Delbouille, A.; Derouane, E. G.; Indovina, V.; Walters, A. B. (Stanford Univ., Calif.). J. Amer. Chem. Soc.; 94: No. 19, 6622-30(20 Sep 1972).

The H_2-D_2 equilibration at 78°K was studied in a flow system over three varieties of MgO powders with or without addition of impurities. The only impurity that affected the catalytic activity consisted of protons, the surface content of which could be regulated by pretreatment of the samples in vacuo at temperatures between 500 and 900°C. Thus, samples were prepared with catalytic activity differing by more than five orders of magnitude. The activity was correlated with the spin density of an electron-deficient paramagnetic center which was shown to be a surface center. The exchange-narrowed symmetrical EPR line, corresponding to this new V-like center called V_I, was assigned to a triangular array of O^- ions situated on a (111) plane of MgO. The catalytic site then consists of an OH^- ion adjacent to the V_I center which adsorbs the deuterium molecule to form a quasi-sorbed Rideal–Eley transition state bringing about exchange. The proposed ion–molecule type reaction explains its low activation energy (2 kcal mol^{-1}) and the possibility of carrying out the reaction at 78°K without the participation of transition metal ions. The apparent necessity of metastable (111) planes on MgO for obtaining catalytic sites and V_I centers was suggested by the irreversible loss of activity and spin density upon heating MgO samples in the presence of H_2O vapor at temperatures at which recrystallization sets in with a change of crystal habit. Thus the catalytic site is associated with a proton impurity, an electronic defect, and a specified crystallographic plane. (auth)

55814 ISOTOPIC EXCHANGE KINETICS BETWEEN TRIS-ACETYLACETONATOCOBALT(III) AND ACETYLACETONE–^{14}C IN ORGANIC SOLVENTS. Saito, Kazuo; Murakami, Mizue (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap.; 45: No. 8, 2472-5(Aug 1972).

The isotopic exchange proceeds faster than the decomposition of the complex above 80°C and below 120°C. McKay plot gives a linear diagram at the initial stage of isotopic exchange. The rate is expressed by $R = [\text{complex}](k_1 + k_2[\text{acacH}])$, where acacH stands for free acetylacetone. The Arrhenius activation energy decreases in the order anisole (25 kcal per mole), chlorobenzene (21), and toluene (18) and is subject to acid catalysis with a strong acid as trichloroacetic. Comparison of the data with those of racemization of this complex, and isomerization and inversion of tris(benzoylacetonato)cobalt(III) suggested that k_1 represents dissociation mechanism through a five coordinate intermediate containing a unidentate acetylacetonate anion, and the k_2 an association mechanism involving association of free acacH with the intermediate. (auth)

Feed Materials Processing

Refer also to abstracts 55647, 55948, and 56078.

55815 METHOD OF PURIFYING UF_6. Carles, Maurice; Fra, Jacky (to Commissariat a l'Energie Atomique). French Patent 2,091,897. 21 Jan 1972. Filed 8 Apr 1970. (In French).

A method of purifying UF_6 polluted with impurities such as MoF_6 or WF_6 in view of using the purified product in U enrichment plants is presented. The polluted UF_6 is distilled from the liquid phase in the presence of ClF_3, this product forming an azeotropic mixture with the MoF_6 and WF_6. These impurities are withdrawn from the head of the column; the purified UF_6 is collected at the base of the column. The ClF_3 at the head of the column may be regenerated, periodically or continuously. (France)

55816 METHOD OF PROCESSING URANATES. Cadilhac, Joseph; Sialino, Ernest; Sugier, Pierre (to Commissariat a l'Energie Atomique). French Patent 2,091,883. 21 Jan 1972. Filed 26 Mar 1970. (In French).

Uraniferous preconcentrate magnesium uranate is reacted with nitric acid in the presence of calcium fluoride; after filtration, the uranyl nitrate solution obtained is treated with TBP and the uranium is extracted in the form of pure uranyl nitrate. If necessary the de-uranified liquors are neutralized using chalk at a pH of 2.5, in order to isolate vanadium from the processed products. (France)

Radiation Chemistry

Refer also to abstracts 55905, 56225, 56229, 56280, 58118, and 58405.

55817 (ANL–7930) CHEMISTRY DIVISION ANNUAL REPORT, JULY 1970–JUNE 1971. Hyman, Herbert H. (ed.) (Argonne National Lab., Ill.). Mar 1972. Contract W-31-109-Eng-38. 158p. Dep. NTIS.

Much of the research summarized revolves around the nuclear and chemical behavior of the heavy elements. These include detailed studies of the fission process, and α, β, and γ radiation. Systematic chemical and radiochemical studies as well as emission and absorption spectroscopic measurements are reported for many of these relatively rare elements. Radiation chemistry, including photochemistry, represents another major activity with some emphasis on the primary processes found in aqueous systems and the development of facilities and techniques for observations as shortly after irradiation as possible. Photosynthesis and other biologically important chemical systems are being studied. Molecular-beam studies, low-temperature calorimetry, and a number of other physical-chemistry research efforts are described; diverse structural studies employing spectroscopic and diffraction techniques are summarized; and measurements are reported on a number of inorganic systems, most of which have special importance in nuclear-energy programs, or have significant environmental impact, or relate to geo- or cosmochemical problems. Such measurements employ an array of instrumental approaches, which include some locally developed examples of essentially unique capability, especially in the field of mass spectrometry. A central real-time computing system has been integrated into much of the research of the Division. Publications of this research are listed at the end of each section. Author and subject indexes are included. (auth)

55818 (COO–3009-6) ACTION OF RADIATIONS ON SOME BIOLOGICAL MODEL SYSTEMS. Technical Progress Report, 12 September 1971–July 1972. Stein, Gabriel (Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry). [nd]. Contract AT(30-1)-3009. 9p. Dep. NTIS.

Research progress is reported on pulse radiolysis of enzymes, steady-state irradiation of ribonuclease, and divalent sulfur compounds. (M.C.G.)

55819 (LBL–1054) ABSOLUTE ASYMMETRIC SYNTHESIS. Bernstein, William James (California Univ., Berkeley. Lawrence Berkeley Lab.). Aug 1972. Contract W-7405-eng-48. 139p. Dep. NTIS.

Thesis.

Absolute asymmetric synthesis of helicenes with circularly polarized light was observed. Irradiation in the long wavelength region of the diarylolefin precursors with left circularly polarized light always gave helicenes of positive long wavelength optical activity, and vice versa. The optical yield of the helicene was found to be strongly dependent on the wavelength of irradiation and the structure of the precursor. These data indicate a mechanism involving selective excitation of the enantiomeric conformations of the precursors, and also provide information about aryl-ethylene bond rotation in the excited state. This hypothesis suggests a general model which may be extended to other examples of absolute asymmetric synthesis with circularly polarized light, should they be found. Absolute asymmetric synthesis by irradiation of the diarylolefins under high magnetic field was sought, but not found. The differential radiolysis of amino acid enantiomers with ^{14}C beta radiation was also unsuccessful. (auth)

55820 DEPENDENCE OF THE YIELD OF PRODUCTS OF CHEMICAL STABILIZATION ON THE INITIAL ENERGY OF PARTICLES BOMBARDING A TARGET. Firsova, L. P.; Krasnyanskii, A. V. (Moscow State Univ.). Teor. Eksp. Khim.; 8: No. 2, 196-201(1972). (In Russian).

An analysis was conducted of the products from reaction of accelerated atoms or ions with material targets as a function of bombarding energy. Given cases of the diffusion equation and its solution were examined under steady-state conditions for absorbing and reflecting supports. A possibility of extreme dependence of yields and retention on the initial energy of the particles is pointed out. The position of the maximum is determined by the target thickness, its density, and properties of the support. A displacement of the maximum toward the region of lower energy may be anticipated from the introduction of a moderator into the target as an impurity. (tr-auth)

55821 UNSTABLE INTERMEDIATES. 113. E.s.r. DATA FOR R_2CXR_3 RADICALS, WHEN X IS FROM GROUP IV OR V. EVIDENCE AGAINST SIGNIFICANT $d(\pi)-p(\pi)$ BONDING. Lyons, A. R.; Neilson, G. W.; Symons, M. C. R. (Leicester Univ., Eng.). J. Chem. Soc., Faraday Trans., II; 68: No. 5, 807-13 (1972).

A wide range of $R_2\dot{C}XR_3$ radicals was prepared, generally in the solid-state, by γ-irradiation of the corresponding alkyl derivatives such as R_4Sn, R_4Pb, R_4P^+ hal$^-$ and R_4As^+ hal$^-$. From the magnitudes of the hyperfine coupling to α-protons, methyl protons, and X nuclei, it is concluded that for all these radicals, delocalization onto X is undetectably small, and therefore $\lesssim 1\%$. Arguments in favor of π-bonding, previously adduced from trends in the g-values for radicals containing Group IV elements, are shown to be unconvincing, since for Group V elements the trend is reversed. (auth)

55822 ELECTRON SPIN RESONANCE AND CNDO/2 STUDY OF THE RADICALS PRODUCED DURING FAST ELECTRON IRRADIATION OF SUBSTANCES CONTAINING NITROGEN. 2. HYDRAZINE. Fantechi, R.; Helcke, G. A. (Joint Nuclear Research Center, Ispra, Italy). J. Chem. Soc., Faraday Trans., II; 68: No. 6, 924-33(1972).

The hydrazine cation and the hydrazyl radical were observed during fast electron irradiation of liquid hydrazine adsorbed in a zeolite matrix. The hydrazyl radical was identified and its structure investigated by comparing the results of ESR measurements and CNDO/2 molecular orbital calculations. The radical can be described as having a trigonal nitrogen on one side and on the other a nitrogen with a geometry intermediate between trigonal and pyramidal. Restricted rotation about the N–N bond is shown to be responsible for an alternating line width effect apparent in the ESR spectrum. The same considerations lead to the conclusion that the cation is probably planar at low temperatures but bent at high temperatures. (auth)

55823 RADIOCHEMICAL DECOMPOSITION OF SILVER AZIDE IN AN ANIONIC SUB-LATTICE. Pyabykh, S. M.; Mehskov, V. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 15: No. 5, 652-3(1972). (In Russian).

Gas evolution rates from the radiolysis of AgN_3 were measured during the irradiation of samples of pure AgN_3, AgN_3 + 5% Pb^{2+}, and AgN_3 + 0.5% Cu^{2+} with x rays at a rate of 2×10^{17} eV/sec/g in the temperature range 20 to 150°C in a vacuum. The rate of gas evolution was constant after the initial period of irradiation of 2 min. Pure AgN_3 exhibited the lowest rate of gas evolution; that contaminated with 0.5% Cu^{2+} the greatest. Gas evolution did not cease immediately upon termination of the irradiation period but persisted for 3 to 6 min. The energy of activation of the process was 9 kcal/mole. (K.S.W.)

55824 ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF IRRADIATED FROZEN AQUEOUS SOLUTIONS. 13. AQUEOUS SOLUTIONS OF CARBOHYDRATES. Makarov, I. E.; Ershov, B. G.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 1, 106-11(Jan 1972). (In Russian).

The formation of free radicals during γ irradiation of vitreous carbohydrates and their aqueous solutions was investigated with EPR and optical spectroscopy. The vitreous (noncrystalline) state facilitates the identification of free radicals because of its homogeneity; it was obtained by heating the four sugars (sucrose, glucose, mannose, and xylose) to the melting point under vacuum. Aqueous solutions (2.5 to 5M) were frozen in liquid nitrogen and irradiated with a ^{60}Co source at 77°K. Yields of free radicals and captured electrons and their probable sites within the carbohydrate molecules are discussed. (K.S.W.)

55825 RADIATION CHEMISTRY AND PHOTOCHEMISTRY OF OXYCHLORINE IONS. I. RADIOLYSIS OF AQUEOUS SOLUTIONS OF HYPOCHLORITE AND CHLORITE IONS. Buxton, G. V.; Subhani, M. S. (Cookridge Hospital, Leeds, Eng.). J. Chem. Soc., Faraday Trans., I; 68: No. 5, 947-57(1972).

The radiolysis of aqueous solutions of ClO^- and ClO_2^- was investigated using pulse and steady state methods. The absorption spectrum of ClO was identified (λ_{max} = 280 nm) and the complete reaction mechanism was established in the case of ClO^- and proposed in the case of ClO_2^-. The following rate constants were evaluated (units of $M^{-1}s^{-1}$): $e^-_{aq} + ClO^- \rightarrow Cl^- + O^-$ $(5.3 \pm 1.0) \times$

10^{10}, $e^-_{aq} + ClO_2^- \rightarrow ClO^- + O^-$ (4.5 ± 0.5) × 10^{10}, $OH + ClO^- \rightarrow ClO + OH^-$ (9.0 ± 0.5) × 10^9, $OH + ClO_2^- \rightarrow ClO_2 + OH^-$ (6.3 ± 0.5) × 10^9, $O^- + ClO^- \rightarrow ClO + O^{2-}$ (2.4 ± 0.1) × 10^8, $O^- + ClO_2^- \rightarrow ClO_2 + O^{2-}$ (1.9 ± 0.1) × 10^8, $2ClO \rightarrow Cl_2O_2$ 1.5 × 10^{10} (2k). Values of the radical and molecular yields obtained for dilute alkaline solution are: $G(e^-_{aq}) + G(H) = 2.92 \pm 0.05$, $G(OH) = 2.41 \pm 0.12$, $G(H_2) = 0.42 \pm 0.02$ and $G(H_2O_2) = 0.70 \pm 0.01$. (auth)

55826 ABSORPTION SPECTRUM OF POLY(METHYL METHACRYLATE) IRRADIATED WITH DOSES TO 10^8 R. Kuz'menko, N. P.; Dergachev, N. P. At. Energ. (USSR); 33: No. 1, 595-6(Jul 1972). (In Russian).

Samples of poly(methyl methacrylate) were irradiated with a ^{60}Co source, and the optical absorption of the polymer was determined as a function of the absorbed dose. The absorption range of 320 to 1000 mμ was studied in polymers exposed to 10^6, 10^7, and 10^8 R; doses in excess of 10^8 R resulted in brittle samples which cracked spontaneously. (K.S.W.)

55827 RADIATION CHEMISTRY OF BUTAN-1-OL. Ackerman, L. G. J.; Basson, R. A.; Van der Linde, H. J. (Atomic Energy Board, Pretoria). J. Chem. Soc., Faraday Trans., I; 68: No. 7, 1258-66(1972).

The radiolysis products of butan-1-ol were determined at low doses. The effects of total energy input, oxygen, and ferric chloride on the yields of the products were studied. The results are interpreted in terms of primary ionic fragmentations and an attempt was made to correlate the radiolysis results with mass spectral data. Consideration was given to the effect of increasing chain length on the relative radiolytic stability of various bonds in the molecule. (auth)

55828 RADIOLYSIS OF CARBOXYLIC COMPOUNDS. 1. COMPARISON OF POTASSIUM ACETATE AND ACETIC ACID RADIOLYSIS. Lukac, S.; Teply, J.; Vacek, K. (Ceskoslovenska Akademie, Ved, Rez). J. Chem. Soc., Faraday Trans., I; 68: No. 8, 1377-83(1972).

Measurement of the yields of CO_2, CO, H_2, CH_4, C_2H_6 and of trapped paramagnetic species reveals substantial differences in the radiolysis of CH_3COOH and CH_3COOK both at room temperature and 77°K. Microwave power saturation of ESR spectra in both CH_3COOH and CH_3COOK was observed. Anion radical $(CH_3COOH)^-$ is the main trapped paramagnetic species in CH_3COOH at 77°K; an additional structure at microwave power below 15 μW was discovered. In irradiated CH_3COOK the radical $\cdot CH_2COO^-$ was found as a main paramagnetic species; in addition to that a quartet assigned to $\cdot CH_3$ radical and a broad singlet were observed. The temperature dependence of the final product yields and of paramagnetic species is also presented. The possible reasons for the differences observed in the radiolysis of both compounds are discussed. (auth)

55829 REACTIONS OF THE HO_2 RADICAL IN AQUEOUS SOLUTION WITH BROMINE AND RELATED COMPOUNDS. Sutton, H. C.; Downes, M. T. (Inst. of Nuclear Sciences, Lower Hutt, N. Z.). J. Chem. Soc., Faraday Trans., I; 68: No. 8, 1498-1507(1972).

A flow system was used to produce HO_2 in concentrations up to 38 μM by the radiolysis of oxygen saturated aqueous formate solutions. Rate constants for the following reactions were obtained by competitive studies, relative to the known rate of reaction of O_2^- with tetranitromethane: $HO_2 + Br_2 \rightarrow H^+ + O_2 + Br_2^-$, $k = (1.1^{+0.6}_{-0.4}) \times 10^8\ M^{-1}s^{-1}$, $O_2^- + Br_2 \rightarrow O_2 + Br_2^-$, $k = (5.6 \pm 0.7) \times 10^9\ M^{-1}s^{-1}$, $HO_2 + Br_3^- \rightarrow H^+ + O_2 + Br^- + Br_2^-$, $k < 10^7\ M^{-1}s^{-1}$, $O_2^- + Br_3^- \rightarrow O_2 + Br^- + Br_2^-$, $k = (3.8 \pm 0.7) \times 10^9\ M^{-1}\ s^{-1}$, $O_2^- + HOBr \rightarrow OH^- + O_2 + Br$, and $k = (9.5 \pm 0.8) \times 10^8\ M^{-1}s^{-1}$. (auth)

55830 POST-RADIATION INDUCED POLYMERIZATION OF STYRENE EMULSION IN THE PRESENCE OF A CHAIN TRANSFER AGENT. Pukhovitskii, V. I.; Polikarpov, V. V.; Karpov, V. L. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. B; 14: No. 6, 426-9(Jun 1972). (In Russian).

An equation and a kinetic scheme were developed, which describe the kinetics of radioinduced emulsion post-polymerization in the presence of the chain transfer agent CCl_4. The yield probability with respect to the free radical formed during transfer was found to be 0.03 for the post-polymerization of styrene from a latex of particles. An assumption as to the energy barrier that interfered with the yield of low-molecular radicals from latex particles is discussed. (tr-auth)

55831 THERMALLY STIMULATED CONDUCTIVITY OF γ-IRRADIATED TRIETHYLAMINE AND 3-METHYLPENTANE GLASSES. Munjal, Ashok K.; Kevan, Larry (Wayne State Univ., Detroit). Contract AT(11-1)-2086. J. Phys. Chem.; 76: No. 19, 2781-4(14 Sep 1972).

Thermally stimulated conductivity of ^{60}Co γ-irradiated and unirradiated triethylamine was studied as the glassy matrix was warmed from 77°K. The unirradiated matrix gives a peak near 117°K which can be removed by field orientation upon freezing the matrix. The irradiated matrix gives evidence for three different types of radiation-produced species as indicated by conductivity peaks in different temperature ranges. At 77°K a peak is observed which decays in about 20 min and can be assigned to a small population of shallow trapped electrons. The main population of trapped electrons is released in the 107 to 117°K temperature range which corresponds well with EPR data. This conductivity peak is reduced by the electron scavengers, carbon tetrachloride, and biphenyl. The third conductivity peak appears between 147 and 157°K and is attributed to molecular ions. At higher temperatures the background intrinsic conductivity increases monotonically and is characterized by an Arrhenius activation energy of 0.20 eV. A few experiments were also carried out on glassy 3-methylpentane to compare with two published studies of thermally stimulated conductivity in this matrix which are divergent. Results confirm those of Wiseall and Willard. (auth)

55832 ROLE OF LOW-ENERGY RESONANCES IN SOME ELEMENTARY PROCESSES OF RADIATION CHEMISTRY. Funabashi, K.; Kajiwara, T. (Univ. of Notre Dame, Ind.). J. Phys. Chem.; 76: No. 19, 2726-32(14 Sep 1972). (COO-38-837).

A qualitative argument is presented to show that the preexisting trapping potentials of electrons in molecular liquids or glasses are related to fluctuations in polarization energies and transfer energies, and are deeper and more numerous for nonspherical molecules (n-hexane) than spherical ones (neopentane). These preexisting potentials are shown to have a large effect on the dynamic behaviors of excess electrons, such as electron mobilities and the spread of electron distribution in epithermal energy region, through the large resonance scattering cross sections, apart from the trivial consequence that the electron could eventually be trapped in these potentials. The scattering cross sections for S and P waves for a spherical potential well are calculated explicitly and are plotted as a function of electron energy and the strength of the potential. (auth)

55833 STUDIES ON THE FORMATION OF PRIMARY HYDROGEN ATOM YIELD (G_H) IN THE γ RADIOLYSIS OF WATER. Draganic, Z. D.; Draganic, I. G. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Phys. Chem.; 76: No. 19, 2733-7(14 Sep 1972).

The formation of G_H was studied in γ-irradiated, neutral, aqueous solutions containing selected mixtures of scavengers for hydrated electron and hydroxyl radical. Experimental verification was made of various assumptions based on the free-radical model of water radiolysis. It was confirmed that the formation of H atoms through the reaction $e^-_{aq} + H_3O^+_{aq} \rightarrow H + H_2O$ can be strongly influenced by scavenging hydrated electrons; a cation (Cu^{2+}), an anion (NO_3^-), and neutral species (H_2O_2 and acetone) were used for scavenging hydrated electrons. It has been shown that the depression of G_H could be quantitatively correlated with the reactivity toward e^-_{aq}. Also, it has been demonstrated that an efficient removal of OH radicals leads to an increase in G_H, by depressing the water re-forming reaction ($OH + e^-_{aq}$) and leaving more e^-_{aq} available for increased H-atom formation in the reaction with hydronium ion. These effects were also observed in solutions containing simultaneously larger amounts of scavengers for OH and e^-_{aq}. Experimental curves agree reasonably well with Kuppermann's predictions based on a diffusion-kinetic model of water radiolysis. Experimental results point to 0.58 as probably the best value for G_H. It was estimated that two-thirds of the primary hydrogen atom yield originates in the reaction of e^-_{aq} with $H_3O^+_{aq}$. It was also found that iodide and bromide ions react efficiently with hydrogen atoms in neutral solutions: $k(H + I^-) = 4 \times 10^7\ mol^{-1}\ sec^{-1}$ and $k(H + Br^-) = 3.3 \times 10^7\ mol^{-1}\ sec^{-1}$. The corresponding value for chloride ion was estimated as $<10^5\ mol^{-1}\ sec^{-1}$. (auth)

55834 ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF NH_2 RADICALS FORMED BY γ IRRADIATION OF AMMONIATED ZEOLITES. Vansant, E. F.; Lunsford, J. H. (Texas A and M Univ., College Station). J. Phys. Chem.; 76: No. 19, 2716-18(14 Sep 1972).

Spectra of $^{14}NH_2$, $^{15}NH_2$, and $^{14}ND_2$ were observed in γ-irradiated NaA, NaY, and HY zeolites which contained ammonia. The spectra of the respective radicals were essentially the same in each of the three zeolites. The anisotropic nitrogen hyperfine structure indicates that the unpaired electron is partially in a p orbital on the nitrogen. A nearly isotropic proton coupling constant of 26G is in good agreement with the splitting observed for NH_2 radicals in other matrices. The rotational hindrance and the stabilization of NH_2 are attributed to hydrogen bonds with lattice oxygen ions. (auth)

55835 MOLECULAR WEIGHT DISTRIBUTION OF POLYETHYLENE PRODUCED BY RADIATION POLYMERIZATION IN A HETEROGENEOUS SYSTEM. Watanabe, Terutaka; Wada, Takeshi;

Machi, Sueo; Takehisa, Masaaki (Japan Atomic Energy Research Inst., Takasaki). J. Polym. Sci., Part B; 10: No. 9, 741-5(Sep 1972).

The molecular weight distributions of γ-induced polymerized polyethylene were found to be markedly affected by the presence of media such as cyclohexane, 2,2,4-trimethylpentane, and tert-butyl alcohol containing 5 vol % of water. Both bimodal and unimodal distributions were observed for the polymers formed in 2,2,4-trimethylpentane and in tert-butyl alcohol, while in cyclohexane only a unimodal distribution was observed. These results on the molecular weight distributions are discussed on the basis of the heterogeneity of the polymerization system and the mobility of polymer chains. (auth)

55836 ELEMENTARY PROCESSES IN THE RADIOLYSIS OF AQUEOUS NITRIC ACID SOLUTIONS: DETERMINATION OF BOTH G_{OH} AND G_{NO_3}. Matthews, R. W.; Mahlman, H. A.; Sworski, T. J. (Oak Ridge National Lab., Tenn.). J. Phys. Chem.; 76: No. 19, 2680-4(14 Sep 1972).

Kinetic evidence is presented for concurrent production of two oxidizing radicals in the radiolysis of aqueous 4.0 M nitric acid solutions: OH and NO_3 radicals that are presumed to result from the direct interaction of ionizing radiation with water and nitric acid species (NO_3^- and HNO_3), respectively. The evidence was obtained from the dependence of G(Ce(III)) on cerium(III) and formic acid concentrations in the radiolysis of cerium(IV)–cerium(III)–formic acid mixtures in air-saturated 4.0 M nitric acid solutions with ^{60}Co γ radiation. $G_{OH} = 2.04 \pm 0.09$ and $G_{NO_3} = 1.56 \pm 0.12$ were determined with the use of a computer to fit experimental data by the method of least squares to a kinetic equation containing 13 dependent variables. It was assumed that energy is partitioned between water and nitric acid species in proportion to their electron fraction. If this be true, then there is no evidence for oxidation of nitric acid species by precursors of OH radical such as H_2O^+ since G_{OH} was found to be proportional to electron fraction water. (auth)

55837 EVIDENCE FOR TRYPTOPHAN RESIDUES BEING ESSENTIAL TO THE ACTIVITY OF PAPAIN. Redpath, J. L. (Mount Vernon Hospital, Northwood, Eng.). Int. J. Radiat. Biol.; 22: No. 1, 99-101(Jul 1972).

Active papain in aqueous solution (0.56 ± 0.03 mg/ml) was irradiated with ^{60}Co γ rays at a dose rate of 1.27 krads/min for up to 9 min. After irradiation, samples were given post-irradiation repair or non-repair treatments, repair samples being incubated for 1 hr with a 1000 fold excess of cysteine. Post-irradiation inactivation plots were obtained from N_2O saturated solutions in the absence of any added solute, and in the presence of CNS^- and Br^- (4×10^{-2} M). It is pointed out that $(CNS)_2^-$ reacts only with cysteine (reduced form) and tryptophan at neutral pH, and that Br_2^- is slightly less selective. The following conclusions were drawn: (1) Total inactivation increased in the order OH, $<Br_2^-$ $<(CNS)_2^-$. (2) The amount of repairable inactivation increased in the order OH, $<Br_2^-$, $<(CNS)_2^-$. The amount of non-repairable inactivation was the same for Br_2^- and $(CNS)_2^-$ and this was approximately twice that observed for OH radicals. (UK)

55838 RADIATION-INDUCED OXIDATION OF AQUEOUS SOLUTIONS OF HYDROQUINONE. Fellows, T. J.; Hughes, G. (Univ. of Liverpool, Eng.). J. Chem. Soc., Perkin Trans., II; No. 9, 1182-5(1972).

The radioinduced oxidation of hydroquinone in aqueous solution was investigated. The products are hydrogen peroxide, p-benzoquinone, and 2-hydroxy-p-benzoquinone. The yields are pH-dependent and G(2-hydroxy-p-benzoquinone) decreases to zero at low pH. The effect of solutes on G(p-benzoquinone) was also investigated and a mechanism suggested for the reactions occurring. (auth)

55839 RADIATION CHEMISTRY OF CARBOHYDRATES. XVIII. THE EXTREME AND VARIABLE SUSCEPTIBILITY OF CRYSTALLINE LACTOSE TO IONISING RADIATIONS. Ahmed, N. U.; Baugh, P. J.; Phillips, G. O. (Univ. of Salford, Eng.). J. Chem. Soc., Perkin Trans., II; No. 10, 1305-9(1972).

Acid production (G = ~45) and overall decomposition (−G = ~55) of α-lactose monohydrate after γ irradiation are considerably higher than for the anhydrous α- and β-anomers, which behave similarly ($G_{acid} = \sim 3.2$; $-G = \sim 22$). Production of stable radicals is the same for all the anomers ($G_{radical} = \sim 3.9$). Diffuse reflectance and ir spectroscopy confirm that the enhanced yield of acid products for the monohydrate occurs directly in the solid state. It is suggested that the remarkable radiation susceptibility of the monohydrate could be a function of the crystal structure in which one water molecule is hydrogen-bonded to four lactose molecules. The presence of water promotes acid production and this is manifested in a high radiation decomposition. When water is absent the acid yield is low and irradiation leads to an enhanced neutral product formation but an overall lower degree of destruction. (auth)

55840 ELECTRON SPIN RESONANCE STUDIES OF ELEMENTARY PROCESSES IN RADIATION- AND PHOTO-CHEMISTRY. 8. THERMAL AND PHOTOCHEMICAL ANNEALING OF γ-IRRADIATED GLYCINE. Ayscough, P. B.; Mach, K. (Univ. of Leeds, Eng.). J. Chem. Soc., Faraday Trans., I; 68: No. 6, 1139-50(1972).

ESR studies of γ-irradiated single crystals of α-glycine and glycine-d_3 between 77 and 403°K show that the primary radical anions are the only species trapped at 77°K. These are converted to a mixture of radicals $NH_3^+CHCOO^-$ and CH_2COOH (or $ND_3^+CHCOO^-$ and CH_2COOD) below 113°K which change in relative proportions on further annealing. The carboxymethyl radicals disappear only at temperatures approaching 370°K. Differences in the relative stabilities of the two types of radicals in the deuterated and non-deuterated samples are observed: these are thought to have their origin in small differences in crystal parameters. Ultraviolet irradiation of γ-irradiated crystals at 77°K produced radicals of structure $NHCH_2COOH$ (or $DNCH_2COOD$) apparently by loss of molecular hydrogen. (auth)

55841 ELECTRON SPIN RESONANCE STUDIES OF ELEMENTARY PROCESSES IN RADIATION- AND PHOTO-CHEMISTRY. 9. CARBOXYLIC ESTERS AT CRYOGENIC TEMPERATURES. Ayscough, P. B.; Oversby, J. P. (Univ. of Leeds, Eng.). J. Chem. Soc., Faraday Trans., I; 68: No. 7, 1153-63(1972).

Some of the reactions occurring during the γ radiolysis of a number of carboxylic esters at cryogenic temperatures were identified by studying the ESR spectra of trapped intermediate radicals. It appears that the capture of thermal electrons by the ester molecule is followed by dissociation of the radical anion by one of two possible processes, each leading to the formation of alkyl radicals. Secondary radicals formed by abstraction of hydrogen from the ester appear during thermal annealing. Ultraviolet irradiation of these radicals leads to the regeneration of alkyl radicals. Hydrogen atoms produced by ultraviolet irradiation of mixtures of hydrogen sulfide and carboxylic esters react to give alkyl and acyl radicals, by a mechanism similar to that proposed for carboxylic acids. (auth)

55842 RADIOLYSIS OF CRYSTALLINE INORGANIC COMPOUNDS. Medvedev, A. S.; Gromov, V. V. (Inst. of Physical Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 4, 796-801(Apr 1972). (In Russian).

A connection between the affinity for an electron of the primary products of radiolysis of inorganic salts and the radiation stability of oxygen-containing ionic compounds was studied. Radiochemical characteristics of chlorates, perchlorates, bromates, nitrates, and sulfates with respect to x rays and ^{60}Co radiation are discussed. With increased affinity for an electron in a series of compounds of this type, the yield of primary products of radiolysis formed by ionization decreased. (K.S.W.)

55843 ELECTRON PARAMAGNETIC RESONANCE SPECTRUM OF IRRADIATED FROZEN AQUEOUS SOLUTIONS. 14. SOLUTIONS OF ACETIC ACID AND POTASSIUM ACETATE. Spitsyn, Vikt. I.; Chernova, G. P.; Ershov, B. G.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 4, 777-82(Apr 1972). (In Russian).

Aqueous solutions of acetic acid (1 to 17.3 mol/l) and CH_3COOK (0.1 to 12 mol/l) were irradiated with a ^{60}Co source at 77°K. Using EPR and optical spectra free radicals were studied in irradiated samples. CH_3COO^- or CH_3COO^{2-}, CH_3, and $e_{capt.}$ were identified and their yields were measured. The thermal and photo-stimulated conversions of free radicals were investigated. A mechanism of free radical production was proposed. (K.S.W.)

55844 DISSOCIATION EQUILIBRIUM OF NITROFORM IN MIXTURES OF POLAR SOLVENTS STUDIED BY PULSE RADIOLYSIS. Chaudhri, S. A.; Asmus, K.-D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). J. Chem. Soc., Faraday Trans., I; 68: No. 6, 1010-16(1972).

The dissociation equilibrium $C(NO_2)_3H \rightleftharpoons C(NO_2)_3^- H_{sol}^+$ and the related kinetics were studied for mixtures of polar solvents. The dissociation constant was found to be essentially controlled by the rate constant for the neutralization of nitroform anions by solvated protons. An almost linear dependence of the pK of nitroform on the solvent composition was observed for tert-butanol–ethylene glycol mixtures. With water as one of the solvent components, a different effect on the dissociation constant was noted and the pK value rapidly attained that for pure water. In mixtures of acetone and alcohols the pK against solvent composition curve goes through a minimum. The results are discussed on the basis of the neutralization kinetics of the nitroform anion. (auth)

55845 INITIATION AND PROPAGATION STEPS IN THE SOLID STATE POLYMERIZATION OF VINYL MONOMERS. Chapiro, Adulphe (CNRS, Bellevue, France). Israel J. Chem.; 10: No. 2, 129-41(1972).

Several problems raised by initiation and propagation steps in solid-state polymerizations are reviewed on the basis of data taken from the literature as well as from unpublished work. The nature of the initial active centers is briefly considered; their addition to double bonds within the crystal is discussed. Examination of initiation yields in radiation-induced polymerizations shows that the efficiency of chain initiation rises with temperature. In most vinyl monomers, the propagation process, which is severely hindered in the crystal, presumably starts at lattice imperfections and thereafter proceeds on behalf of the additional imperfections introduced by the accumulated polymer. In a few specific cases the orientation of the double bonds in the crystal or their localization in certain regions of the crystal favors chain propagation and may result in a stereocontrolled reaction. The role of crystallite boundaries is emphasized particularly in the case of copolymerizations which take place in eutectic mixtures of two monomers. (52 references) (auth)

55846 REACTION OF GASES WITH IRRADIATED SOLIDS HAVING A BILAYER STRUCTURE. Adler, George (Brookhaven National Lab., Upton, N. Y.). Israel J. Chem.; 10: No. 2, 563-72(1972).

The free radicals in irradiated solid amides, fatty acids and similar compounds react rapidly with ambient gases such as O_2, NO, SO_2, etc. The gas seems able to penetrate the lattice and reach the reaction site. This apparently depends on a particular kind of crystal structure which we term the "bilayer structure." Some characteristics of these reactions are discussed. (auth)

55847 AQUOLUMINESCENCE FROM γ-IRRADIATED CRYSTALS: EFFECT OF ISOTHERMAL ANNEALING. Arnikar, H. J.; Damle, P. S.; Chaure, B. D. (Univ. of Poona, India). J. Phys., D (London); 5: No. 6, 1123-6(Jun 1972).

When γ-irradiated alkali halide crystals are dissolved in water a bluish glow extending into the ultraviolet occurs. This "aquoluminescence" was used to study first-order rate constants for isothermal annealing processes and the energy levels of trapped electrons. (auth)

55848 TRIVALENT NICKEL. I. A PULSE RADIOLYTIC STUDY OF THE FORMATION AND DECOMPOSITION OF THE AMMONIACAL COMPLEX IN AQUEOUS SOLUTION. Lati, J.; Meyerstein, D. (Nuclear Research Centre–Negev, Beer Sheva, Israel). Inorg. Chem.; 11: No. 10, 2393-7(Oct 1972).

The oxidation of the $Ni^{II}(NH_3)_n$ complex by radiolytic NH_2 radicals in aqueous solutions yields an unstable trivalent nickel complex. The specific rate of this reaction is $1 \times 10^7\ M^{-1}\ sec^{-1}$. The absorption spectrum of the trivalent complex was measured. The mechanism of disappearance of the trivalent complex is via a second-order reaction with $2k \leq 3.5 \times 10^7\ M^{-1}\ sec^{-1}$. The specific rate of the reaction $OH + NH_3 \rightarrow NH_2 + H_2O$ at pH 11.3 is $2.4 \times 10^7\ M^{-1}\ sec^{-1}$. The specific rate of oxidation of hydrazine by the trivalent nickel complex is $4 \times 10^6\ M^{-1}\ sec^{-1}$. (auth)

55849 TRIVALENT NICKEL. II. A PULSE RADIOLYTIC STUDY OF THE FORMATION AND DECOMPOSITION OF THE ETHYLENEDIAMINE AND GLYCINE COMPLEXES IN AQUEOUS SOLUTION. Lati, J.; Meyerstein, D. (Nuclear Research Center–Negev, Beer-Sheva, Israel). Inorg. Chem.; 11: No. 10, 2397-2401(Oct 1972).

The reaction of hydroxyl radicals with divalent nickel complexes, with ethylenediamine and glycine as ligands, yields unstable intermediates. These unstable intermediates are shown to be complexes of trivalent nickel. The specific rates of formation and decomposition as well as the spectra of these complexes were measured as functions of pH and divalent complex concentration. The mechanism of the reactions involved is discussed and compared with the behavior of the corresponding copper complexes. (auth)

55850 REACTIONS BETWEEN ORGANIC NITROXYL FREE RADICALS AND RADIATION-INDUCED TRANSIENTS IN THE DNA BASES. Brustad, T.; Bugge, H.; Jones, W. B. G.; Wold, E. (Norsk Hydros Institutt for Kreftforskning, Oslo). Int. J. Radiat. Biol.; 22: No. 2, 115-29(Aug 1972).

Second-order rate constants (k′) were determined by pulse-radiolysis technique for reactions of OH-induced transients in each of the four DNA bases, (thymine, cytosine, guanine, adenine) with three organic nitroxyl compounds known to enhance specifically the radioinduced lethality of anoxic cells, thus: [DNA base (OH)] + $RNO^+ \rightarrow$ product. The nitroxyl compounds used were 2, 2, 6, 6-tetramethyl-4-piperidose-N-oxyl (TAN), 2, 2, 6, 6-tetramethyl-4-piperidinol-N-oxyl (TMPN), and Norpseudopelletierine-N-oxyl(NPPN). The reactions were studied in 2×10^{-2}M phosphate buffer, pH 7. (auth)

55851 RADIOLYSIS OF THE SYSTEM NITROGEN–PROPYLENE. FORMATION OF NITROGEN-CONTAINING PRODUCTS. Asatov, Kh.; Dzantiev, B. G.; Shishkov, A. V. (Inst. of Chemical Physics, Moscow). Uzb. Khim. Zh.; No. 3, 50-3(1972). (In Russian).

Binary mixtures (99 : 1 to 10 : 90) of N_2 and propylene were γ-irradiated at 760 mm Hg and over the temperature range 20 to 285°C under static conditions. The radiation source was ^{60}Co (10^{13} eV/cm^3 · sec), and integral doses of 10^{19} eV/cm^3 were given to the gaseous samples. The formation of HCN was studied at 20, 100, 200, and 285°; that of CH_3CN at 200 and 285°C. At 285°C the G-value for HCN reached a maximum at 1 to 5% C_3H_6; the G for CH_3CN peaked at about 20% C_3H_6. Other possible reactions and their mechanisms are considered. (K.S.W.)

55852 RADIATION COPOLYMERIZATION OF VINYL ACETATE WITH VINYL PYRROLIDONE. Tashmukhamedov, S. A.; Karabaev, A. Sh.; Tillaev, R. S. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 3, 54-6(1972). (In Russian).

Degassed monomers of vinyl acetate and vinyl pyrrolidone were mixed and irradiated with a ^{60}Co source at integral doses of 0.05 to 1.0MR of gamma. Copolymerization was practically 100% at 0.8 to 1.0MR, but conversion fell off rapidly with decreasing doses. With methanol or benzene as diluent–solvent, conversions were less than for pure monomer mixture. (K.S.W.)

55853 COPOLYMERIZATION OF N-ETHYLMALEIMIDE WITH STILBENES. Yamakita, Hiromi; Hayakawa, Kiyoshi (Government Industrial Research Inst., Nagoya, Japan). J. Polym. Sci., Part A-1; 10: No. 8, 2223-5(Aug 1972).

Charge-transfer complexes in solutions of ethylmaleimide and stilbenes were characterized by spectroscopy. The stoichiometric compositions of these complexes have been shown by Job's method to be 1 : 1 molar complexes. The value of the equilibrium constant K for complex formation of ethylmaleimide with stilbene derivative increases in the following probable order: ethylmaleimide–stilbene ≪ ethylmaleimide–dimethylaminostilbene (DMAS) < ethylmaleimide–aminodimethylaminostilbene (ADMAS). From the calculations of the electron density of the highest occupied level for the stilbenes, the charge transfer in ethylmaleimide–DMAS and ethylmaleimide–ADMAS is attributed to $n \rightarrow \pi$ transition, while the charge transfer in ethylmaleimide–stilbene is attributed to $\pi \rightarrow \pi$ transition. Copolymerization was carried out by γ irradiation in benzene or THF solutions of the comonomer pairs. The alternating tendency of copolymerization was larger in the ethylmaleimide–DMAS system than in the ethylmaleimide–stilbene system. This can be explained by assuming resonance structures in the transition state of addition reaction of DMAS to the propagating ethylmaleimide unit. In the copolymerization of ethylmaleimide with ADMAS, the effect of the penultimate unit was more important than in that with DMAS. (auth)

55854 RADIATION-INDUCED POLYMERIZATION OF GLASS-FORMING SYSTEMS. II. EFFECT OF TEMPERATURE ON THE POLYMERIZATION RATE AT HIGHER CONVERSION. Kaetsu, Isao; Okubo, Hiroshi; Ito, Akihiko; Hayashi, Koichiro (Japan Atomic Energy Research Inst., Takasaki). J. Polym. Sci., Part A-1; 10: No. 8, 2215-22(Aug 1972).

The effect of temperature and conversion on the polymerization rate at higher conversion was investigated with regard to the γ-ray-induced polymerization of hydroxyethyl methacrylate (HEMA) and glycidyl methacrylate (GMA) in the supercooled phase. The polymerization rate changed from acceleration to depression at various conversions, depending on the polymerization temperature. It was found that T_ν at which the viscosity of the system became ca. 10^3 cpoise influenced the shape of the polymerization time–conversion curve. The experimentally obtained conversion reflection point in the polymerization time–conversion curve agreed with the conversion where the polymerization temperature is the same as the calculated T_ν of the system. When the polymerization temperature was lower than T_ν of the monomer, no acceleration of the polymerization occurred. When the polymerization temperature was higher than T_ν of the polymer, no depression of the polymerization rate was observed. The effect of temperature on the saturated conversion (final conversion) was also examined in terms of T_g of the polymerization system. The experimentally obtained saturated conversion agreed with the conversion where the polymerization temperature is the same as the calculated T_g of the system. (auth)

55855 RADIATION-INDUCED POLYMERIZATION OF GLASS-FORMING SYSTEMS. I. EFFECT OF TEMPERATURE ON THE INITIAL POLYMERIZATION RATE. Kaetsu, Isao; Okubo, Hiroshi; Ito, Akihiko; Hayashi, Koichiro (Japan Atomic Energy Research Inst., Takasaki). J. Polym. Sci., Part A-1; 10: No. 8, 2203-14(Aug 1972).

Radiation-induced polymerization of hydroxyethyl methacrylate (HEMA) and glycidyl methacrylate (GMA) was investigated. HEMA and GMA formed a stable supercooled or glassy phase by themselves at low temperatures. It was found that the initial polymerization rate was proportional to ca. 0.5 power of the dose rate in the region of relatively high temperatures and the dose rate exponent changed sharply to 1.0 at a temperature T_ν, at which the viscosity of monomeric systems reached ca. 10^3 cP as the temperature decreased. Moreover, a maximum in the polymerization rate—temperature curve occurred at T_ν. It was deduced that the polymerization mechanism changed from the stationary to the nonstationary at T_ν. The temperature at which a minimum of the polymerization rate occurred could be calculated kinetically considering the viscosity dependency of termination rate, and it agreed well with that obtained experimentally. It was deduced that occurrence of the minimum polymerization rate above T_ν was attributable mainly to the decrease in termination rate due to diffusion control. (auth)

55856 GRAFT COPOLYMERISATION OF ACRYLIC ACID TO NYLON-6 BY MUTUAL IRRADIATION. PART 3. INFLUENCE OF RADIATION INTENSITY AND MONOMER DIFFUSION. Huglin, M. B. (Univ. of Salford, Eng.); Johnson, B. L. Kolloid-Z. Z. Polym.; 249: No. 1-2, 1080-4(1971).

Gamma irradiation of nylon-6 film in the presence of aqueous acrylic acid and cupric chloride at constant concentrations was studied at different radiation intensities, I, and the following relationships found: Rsub(H) proportional to Isup(1.0) and Rsub(G) proportional to Isup(0.7). Here, Rsub(H) and Rsub(G) denote the initial rates of homopolymerization and grafting respectively. The values of the exponents, 1.0 and 0.7, indicate that in homopolymerization the termination is mainly by cupric ions, whereas in grafting there is a mixed form of termination, viz. by cupric ions and by bimolecular reaction between growing chains. Experiments were conducted on the influence of film thickness, the rates of swelling of grafted and ungrafted films, and the effect of regrafting to grafted films. The results show that a fast rate of grafting accompanied by a slower rate of monomer diffusion does not prevail in this system, and hence it is not a contributory factor to the fall-off observed in the grafting curves. (GF)

55857 PULSE RADIOLYSIS OF METALLIC IONS IN AQUEOUS SOLUTIONS. 1. PULSE RADIOLYSIS IN Hg^{2+} AND $Hg_2{}^{2+}$ IONS AQUEOUS SOLUTIONS. Faraggi, M.; Amozig, A. (Israel Atomic Energy Commission, Beersheba). Int. J. Radiat. Phys. Chem.; 4: No. 3, 353-8(Aug 1972).

The reaction of H atoms (generated by the interaction of fast electrons with water) with Hg^{2+} and Hg_2^{2+} was investigated. Absorption spectra of the transient species in the range of 250 to 800 nm were obtained. Hg^+ formed by the reaction: $Hg^{2+} + H \rightarrow Hg^+ + H^+$ has a maximum absorption (λ_{max}) at 272 nm ($\epsilon_{272} = 780 \pm 20$ m^2 mol^{-1}). Hg_2^+ formed by the reaction: $Hg_2^{2+} + H \rightarrow Hg_2^+ + H^+$ has a λ_{max} at 285 nm ($\epsilon_{285} = 900 \pm 20$ m^{2}mol^{-1}). The decay kinetics of Hg^+ and Hg_2^+ were measured. They are second-order reactions: $Hg^+ + Hg^+ \rightarrow Hg_2^{2+}$, $Hg_2^+ + Hg_2^+ \rightarrow Hg_2^{2+} + 2Hg$ with $2k_5 = (8.0 \pm 1.0) \times 10^9$ dm^3 mol^{-1}s^{-1} and $2k_6 = (1.4 \pm 0.2) \times 10^{10}$ dm^3 mol^{-1}s^{-1}. (auth)

55858 RADIATION STABILITY OF MOLECULES OF ARYLENE-SILOXANE ELASTOMERS OF DIFFERENT STRUCTURE. Kozlov, V. T.; Kashevskaya, N. G. (Scientific-Research Inst. for the Rubber Industry, Moscow). Vysokomol. Soedin., Ser. B; 14: No. 4, 315-16(Apr 1972). (In Russian).

The influence of structure of polydimethylsiloxane that contains various arylene groups in their basic chain on the radiation stability of the polymeric molecules toward decomposition at 77°K was investigated. Typical polymeric chains investigated are: $[-(CH_3)_2Si-Ar-Si(CH_3)_2O-Si(CH_3)_2O-]_x$ and $[-(CH_3)_2Si-Ar-O-Ar-Si(CH_3)_2)-]_x$, where Ar represents a benzene ring or other aromatic ring. The radiation stability increased when the arylene groups were substituted in the meta-position (in contrast to the para-position), and if O or S atoms were inserted between the arylene groups. (K.S.W.)

55859 DIRECTION OF CHANGE IN A GRAFT COPOLYMER STRUCTURE. Babkin, I. Yu.; Krasnogorov, A. I.; Kitaev, K. N. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. B; 14: No. 4, 259-62(Apr 1972). (In Russian).

Experiments were conducted in order to follow structural changes of the grafted phase which may purposely be evoked by different procedures in solvent removal and heating. Adsorption behavior of the polymeric materials of argon or water vapor provided information with respect to these changes. The two systems studied were: polytetrafluoroethylene with grafted polyacrylonitrile and polytetrafluoroethylene with grafted polystyrene. The polytetrafluoroethylene powder was exposed to the monomer of the second component in the vapor phase while irradiated with ^{60}Co gamma radiation. Various solvent removal and heating regimes of these grafted copolymers resulted in structure changes. (K.S.W.)

55860 INFLUENCE OF NETWORK DENSITY OF RADIATION-VULCANIZED SILICONE RUBBERS ON COLD RESISTANCE. Evseev, A. G.; Agafonova, E. E.; Kozlov, V. T.; Zubov, P. I. (Scientific-Research Inst. of the Rubber Industry, Moscow). Vysokomol. Soedin., Ser. B; 14: No. 4, 299-300(Apr 1972). (In Russian).

An investigation of the radiation vulcanization process in silicone rubbers showed that the cold resistance of the vulcanizates depended on the density of the vulcanized chains. With an increase in the extent of transverse crosslinking from 8×10^{19} to 16×10^{19} crosslinks in the vulcanizates, the cold resistance of the latter increased. (K.S.W.)

55861 FORMATION OF CYCLOHEXANONE OXIME BY GAMMA IRRADIATION OF CYCLOHEXANE IN THE PRESENCE OF NO AND HCl. Hummel, R. W. (Atomic Energy Research Establishment, Harwell, Eng.). Int. J. Radiat. Phys. Chem.; 4: No. 3, 383-7(Aug 1972).

The γ-irradiation of liquid cyclohexane with gaseous NO and HCl at 10°C gives a yield of cyclohexanone oxime (G = 5.46 molecules/100 eV) which is consistent with published values of the yield of cyclohexyl radicals from irradiated pure cyclohexane. (auth)

55862 RADIATION-INDUCED BINDING OF METHIONINE WITH SERUM ALBUMIN, TRYPTOPHAN, OR PHENYLALANINE IN AQUEOUS SOLUTION. Yamamoto, Osamu (Hiroshima Univ.). Int. J. Radiat. Phys. Chem.; 4: No. 3, 335-45(Aug 1972).

It was confirmed that γ-rays cause methionine to bind with serum albumin, tryptophan or phenylalanine in aqueous solution under aerobic conditions. In the radiation-induced binding of methionine with serum albumin, it was concluded by the use of some scavengers that there was an indirect participation of the hydroxyl radical but no participation of the hydrated electron. The oxidized substances derived from methionine, methionine sulfoxide and methylsulfonic acid, no longer have this binding activity. In addition the formation of methylsulfonic acid from methionine, which has not been reported as a radiolytic product, was noted. (auth)

55863 DETERMINATION OF THE PRIMARY MECHANISMS IN THE RADIOLYSIS OF GASEOUS HYDRAZINE. Blais, J.; Gitton, B.; Cottin, M. (Institut du Radium, Paris). Int. J. Radiat. Phys. Chem.; 4: No. 3, 369-81(Aug 1972). (In French).

In order to determine the energy thresholds at which the products of the radiolysis of N_2H_4 (viz. N_2, H_2 and NH_3) appear, hydrazine vapour was irradiated under dynamic conditions at a pressure of 6×10^{-3} torr (0.8 N m^{-2}) by a beam of electrons, the energy of which could be varied between 10 and 100 eV. Another series of experiments was carried out by irradiation of hydrazine vapour under static conditions at a pressure of 14 torr (1.9 kN m^{-2}) by alpha rays in an apparatus which also enabled the effect of an electric field on the radiolysis to be determined. The results obtained seem to indicate that the radiolytic decomposition of N_2H_4 is initiated by two primary acts: an excitation producing N_2 and H_2, and an ionization producing N_2 and NH_3. At low pressure these two mechanisms are of comparable importance; at higher pressure the latter one initiating a chain becomes preponderant. This radiolytic study showed the importance of the catalytic decomposition of N_2H_4 on the walls. It leads to the formation of NH_3, N_2, H_2 and an unidentified fourth compound which could be N_3H. This latter product is destroyed by the radiation under static conditions. The mean energy necessary to produce an ion pair in hydrazine vapour is determined to be about 33 eV. (auth)

55864 TRIPLET STATE FORMATION IN PULSE RADIOLYSIS. Singh, Ajit (Atomic Energy of Canada, Ltd., Pinawa, Manitoba). Radiat. Res. Rev.; 4: No. 1, 1-47(Aug 1972).

Mechanisms of formation of excited states are considered. Ion recombination, energy transfer, subexcitation electrons, ion—molecule reactions, and rate of superexcited states are discussed. Information is given in the appendix on some of the systems studied. (282 references). (M.C.G.)

55865 PREPARATIVE ORGANIC RADIATION CHEMISTRY. Wilson, J. G. (Australian Atomic Energy Commission, Sutherland, New South Wales). Radiat. Res. Rev.; 4: No. 1, 71-121 (Aug 1972).

The radioinduced reactions considered include: addition to carbon—carbon double and triple bonds, substitution reactions, cycloaddition reactions, synthesis of labeled compounds, and other miscellaneous reactions. Advantages of using γ radiation to initiate chemical reactions are considered. (106 references). (M.C.G.)

55866 SECONDARY RADICAL PROCESSES IN CONALBUMIN IRRADIATED IN THE DRY STATE. Crippa, P. R.; Vecli, A. (Univ., Parma, Italy). Int. J. Radiat. Biol.; 22: No. 2, 105-13(Aug 1972).

The kinetics of the formation of sulphur and peptidic radicals by warming, observed in sulphur-containing proteins, was studied by EPR techniques on different kinds of conalbumin x-irradiated at liquid N_2 temperature. It is pointed out that as conalbumin can be obtained with 2-, 1- and 0-iron ions, this type of experiment can help to clarify the mechanisms by which metal ions interact with the processes of radical conversion. The results show that the processes of the formation of the two stable radicals $-NH-CH-CO-$ and $-CH_2-S\cdot$, after the initial step of absorption of radiant energy, followed two different and noninteracting pathways. Irradiation was with soft x rays at a dose rate of 10^4 R/min. Total absorbed doses were between 2×10^5 and 5×10^5 rads. Annealing was carried out over the range 113 to 353°K. (auth)

55867 KINETICS OF THERMAL DECOMPOSITION OF $KMnO_4$ IRRADIATED BY NEUTRONS. **Protashchik, V. A. (Inst. of Nuclear Energy, Minsk). Dokl. Akad. Nauk BSSR; 16: No. 7, 623-5(Jul 1972). (In Russian).**

The possibility of quantitative calculation of the effect of a prior irradiation by a neutron flux of reactor origin on the thermal decomposition of $KMnO_4$ is demonstrated using topokinetic relationships. Most of the argument is based on the equation of Kolmogorov and Erofeev: $\alpha = 1 - e^{-kt^n}$. (K.S.W.)

55868 ORIGIN OF SATURATED HYDROCARBONS C_{n+1} IN THE RADIOLYSIS OF NORMAL ALKANES C_n. Avdonina, E. N.; Makarov, V. I. (Moscow State Univ.). Int. J. Radiat. Phys. Chem.; 4: No. 3, 259-64(Aug 1972). (In Russian)

The data reported on the radiation yields of the saturated C_i compounds produced by radiolysis of C_n n-alkanes are considered ($n < i < 2n$, where n is the number of C atoms in an alkane molecule). Attention was paid primarily to the ratios of radiation yields of the "abnormal" C_{n+1} group of products, to the yields observed for C_{n+2}, C_{n+3}, etc., groups. The "abnormal" ratio of radiation yields in the C_{n+1} group of products was accounted for by Widmer and Gaumann (Helv. Chim. Acta 1964, 46, 944, 2766 and 2780), who suggested that the formation in irradiated n-hexane of the C_7 linear product is due not only to the combination of CH_3 and C_6H_{13} radicals, but, to a considerable extent to the combination of other linear radicals produced from n-hexane. The quantitative kinetic treatment of the data on radiation yields of C_{n+1} products measured by Panchini et al. (Int. J. Radiat. Phys. Chem. 1970, 2, 147) for n-pentane and n-hexane shows that this explanation is not satisfactory. It was noted that the experimentally found ratio of C_{n+1} product yields is very near to the relative abundance of C–H bonds of different types in the irradiated alkane molecule. A new hypothesis is suggested accounting for the observed ratio of yields of all C_{n+1} radiolysis products, linear as well as branched. It is supposed that in the radiolysis of n-alkane, C_{n+1} isomers are produced rather by the indiscriminate insertion of methylene, CH_2 (in a singlet state), into C–H bonds of alkane, rather than by the combination of CH_3 and parent radicals. Some considerations are given supporting this hypothesis. (auth)

55869 EFFECTS OF CHEMICAL INHIBITORS AND IONIZING RADIATION ON ARVIN ACTIVITY. **Beamont, K. P.; Phillips, G. O.; Power, D. M. (Univ. of Salford, Eng.). Int. J. Radiat. Biol.; 22: No. 2, 137-48(Aug 1972).**

Michaelis–Menten (K_m) and maximum velocity (V) values were obtained for the arvin-catalyzed hydrolysis of fibrinogen, benzoylarginine ethyl ester, and toluene-p-sulphonylarginine methyl ester. Optimum conditions of temperature (50°C) and pH (8.0) were determined for hydrolysis of the synthetic substrates. Enzymatic hydrolysis of toluene p-sulphonylarginine methyl ester was competitively inhibited by α-N-benzoyl-L-arginamide. Toluene-o-sulphonyl fluoride and toluene-p-sulphonyl fluoride, on the other hand were noncompetitive inhibitors. Rapid loss of enzymatic activity occurred after γ irradiation (pulse radiolysis at a dose rate of 5.74×10^{16} eV ml^{-1} min^{-1} over a range 0 to 120 eV ml^{-1} $\times 10^{17}$), in argon- and nitrous oxide-saturated solutions. There were indications that e^-_{aq} and OH radicals contribute to a similar extent towards inactivation. Gel filtration of the irradiated enzyme revealed the production of several low molecular weight fragments Extensive destruction of amino acid residues occurred during irradiation in argon. (auth)

55870 RADIOTHERMOLUMINESCENCE OF ALIPHATIC KETONES. **Kroh, Jerzy; Wypych, Maria (Technical Univ., Lodz, Poland). Nukleonika; 16: No. 11-12, 523-30(1971).**

The radiothermoluminescence (RTL) spectra and their distribution $J_{RTL} = f(\lambda)$ for acetone and several other aliphatic ketones, γ-irradiated at 77°K, were investigated. The quantitative and qualitative changes in RTL of acetone depending on dose and the presence of various additives were examined. (auth)

55871 PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS OF ANILINE AND SUBSTITUTED ANILINES. **Christensen, Hilbert (Aktiebolaget Atomenergi, Studsvik, Sweden). Int. J. Radiat. Phys. Chem.; 4: No. 3, 311-33(Aug 1972).**

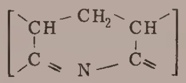
The primary reactions of hydrated electrons, hydrogen atoms and hydroxyl radicals with aniline and the aniline cation in aqueous solutions were studied by the technique of pulse radiolysis and by determination of end products after γ-radiolysis. Hydrogen atoms and hydrated electrons react with aniline to form the cyclohexadienyl type radical with absorption maximum at 355 nm and an extinction coefficient of 410 m^2/mol. A similar radical formed by reaction of hydrogen atoms with the aniline cation has its absorption maximum at 310 nm and an extinction coefficient of 320 m^2/mol. Hydrogen atoms react with the acid and neutral forms of aniline with rate constants of $(1.3 \pm 0.2) \times 10^9$ dm^3 mol^{-1}s^{-1} and $(2.9 \pm 0.7) \times 10^9$ dm^3 mol^{-1}s^{-1}, respectively. OH radicals react with aniline with a rate constant of $(1.4 \pm 0.3) \times 10^{10}$ dm^3 mol^{-1}s^{-1} to form the cyclohexadienyl radical $HOC_6H_5NH_2$ with absorption maximum at 355 nm and the anilino radical with absorption maxima at 300 and 400 nm. The cyclohexadienyl radical decayed in a first-order process with a rate constant of 1.4×10^5 s^{-1} by elimination of NH_3 whereas the anilino radical disappeared in a second-order reaction to form hydrazobenzene. O^- radicals react with aniline at pH 13.3 with a rate constant of $(3.1 \pm 0.6) \times 10^9$ dm^3 mol^{-1}s^{-1} to form anilino radicals. The reaction of OH radicals with the aniline cation produced the anilino radical cation with a rate constant of $(4.8 \pm 0.8) \times 10^9$ dm^3 mol^{-1}s^{-1}. The absorption maximum was placed at 415 nm. The cyclohexadienyl-type radical with absorption maximum at 350 nm was also found in aqueous solution of 2-amino-1,3-dimethylbenzene but was not formed in solutions of N,N′-dimethylaniline. (auth)

55872 RADIATION POLYMERIZATION. XVI. RADIATION-INDUCED SOLID-STATE POLYMERIZATION OF N-METHYLOLMALEIMIDE. **Ivanov, V. S.; Veretennikov, N. V. Vestn. Leningrad. Univ., No. 16, Fiz. Khim.; No. 3, 125-30(Aug 1971). (In Russian).**

N-methylolmaleimide was polymerized in the solid state by ^{60}Co γ rays. Effects of dose, dose rate, temperature, and crystal lattice defects on the polymerization process were investigated. The influence of gases on polymerization of N-methylolmaleimide was ascertained. The polymer is characterized on solubility intrinsic viscosity, temperatures of softening and decomposition, by ir spectra and x-ray diagrams. Film coatings with satisfactory adhesion metal were obtained. (auth)

55873 CYCLOPOLYMERIZATION OF ACRYLONITRILE IN THE VITREOUS STATE UNDER THE INFLUENCE OF γ AND UV RADIATIONS. Kotin, E. B.; Gerasimov, G. N.; Abkin, A. D.; Suleimanov, A. A. (Scientific Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. B; 14: No. 4, 282-3(Apr 1972). (In Russian).

The effect of γ and uv radiations on the glass formed from acrylonitrile and the diethyl ether of diethyleneglycol was studied at −196°C. The action of uv on γ-irradiated glass of this type resulted in some cyclization of the polymer to form



as judged from uv absorption spectra of the product. (K.S.W.)

55874 ELECTRON SPIN RESONANCE AND CNDO/2 STUDY OF THE RADICALS PRODUCED DURING FAST ELECTRON IRRADIATION OF SUBSTANCES CONTAINING NITROGEN. I. FORMAMIDE, UREA, BIURET, AND THIOUREA. **Helcke, G. A.; Fantechi, R. (Joint Nuclear Research Center, Ispra, Italy). J. Chem. Soc., Faraday Trans., II; 68: No. 6, 912-23(1972).**

A detailed study was made of a radical observed during electron irradiation of solid formamide, urea, and biuret. Measurements of the ^{13}C hyperfine coupling tensor and of the g-value tensor, in conjunction with CNDO/2 molecular orbital calculations, strongly support its identification as $OCNH_2$. (auth)

55875 ELECTRON SPIN RESONANCE STUDIES OF ELEMENTARY PROCESSES IN RADIATION- AND PHOTO-CHEMISTRY. 10. CARBOXYLIC ACID ANHYDRIDES AT CRYOGENIC TEMPERATURES. **Ayscough, P. B.; Oversby, J. P. (Univ. of Leeds, Eng.). J. Chem. Soc., Faraday Trans., I; 68: No. 7, 1164-8(1972).**

The four carboxylic acid anhydrides, acetic, propionic, n-butyric and iso-butyric, γ-irradiated at 77°K, show ESR spectra indicating the presence of acyl radicals and radicals formed by loss of H from the anhydride. The latter radicals are derived in part from simple alkyl radical precursors as may be adduced from experiments on thermal annealing of the irradiated samples. No evidence is found for the presence of trapped radical-anions or cations. Hydrogen atoms react with anhydrides at 77°K to give the same types of radicals that are formed during γ-radiolysis, though in different relative yields. (auth)

55876 RADIATION DEGRADATION YIELDS FOR SOME CRYSTALLINE CARBOHYDRATES AND DISTRIBUTION OF

THE DAMAGE WITHIN THE DISACCHARIDE MOLECULE. Loefroth, Goeran (Univ. of Stockholm). Int. J. Radiat. Phys. Chem.; 4: No. 3, 277-83(Aug 1972).

Crystalline carbohydrates were irradiated with ^{60}Co γ-rays and then dissolved in oxygen-free water. The total degradation yields were determined by isotope dilution using ^{14}C labeled carbohydrates and synthesis of suitable derivatives. The initial G values for total degradation were found to be 6 for sucrose, 7 for trehalose dihydrate and 8 for maltose monohydrate. D-fructose and lactose monohydrate are highly radiation sensitive with initial G values for total degradation of about 40 and 50, respectively. Hydrolysis of irradiated sucrose, trehalose dihydrate, and maltose monohydrate followed by determination of the degradation with respect to their monosaccharide constituents shows that the radiation damage is mainly localized to one of the monosaccharide moieties of any damaged disaccharide molecule. Dissolution of irradiated α-D-glucose and lactose monohydrate in oxygen-free and fully oxygenated water and subsequent determination of the total degradation indicate that the presence of oxygen in the water increases the measurable degradation. (auth)

55877 MECHANISM OF CROSS-LINKING MACROMOLECULES BY GRAFTED CHAINS. Kurilenko, A. I.; Krul, L. P.; Yakimtsov, V. P. Vysokomol. Soedin., Ser. B; 14: No. 4, 243-4(Apr 1972). (In Russian).

The structure and thermomechanical properties of materials were studied in which a grafted polymer, obtained by a post-polymerization method, was uniformly distributed throughout. Free radicals were created by 1.5 MR doses of γ radiation in films of polyethylene and poly(methyl methacrylate). The grafted materials include: polyacrylonitrile, polyvinylidene chloride, and poly(methyl methacrylate). Data showed that such grafted films, when heated above the softening temperature, retain their orientation and much of their internal stress, and upon cooling recover their original structure. The mechanism of forming network joints was analogous to an effect of microlayering of the grafted polymer on the basis of incompatible or difficultly compatible polymeric components with the formation of microregions joining similar portions of the chain. (K.S.W.)

55878 EFFECT OF IONIC DISSOCIATION OF ORGANIC COMPOUNDS ON THEIR RATE OF REACTION WITH HYDROGEN ATOMS. Neta, P.; Schuler, Robert H. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 76: No. 19, 2673-9(14 Sep 1972).

Further development of the steady-state in situ radiolysis-ESR method for the determination of H atom reaction rate constants has enabled measurements to be made in neutral solutions. It is possible, in many cases, to use $H_2PO_4^-$ to convert e^-_{aq} into H atoms at pH 7. With certain organic solutes, however, scavenging of e^-_{aq} by the solute interferes with this conversion and it is necessary to use only the low-residual H atom yield with a corresponding reduction in sensitivity of the measurements. Representative organic solutes were examined and it is found that only in the cases where acid-base equilibria are involved does the rate constant depend on pH. Typical increases of a factor of ~2 to 3 are observed for the simple organic acids and amino acids upon conversion of COOH to COO^-. Only in the case of oxalic acid was the rate constant found to decrease in going from pH 1 to 7. Deprotonation of the NH_3^+ group results in an increase in the rate of abstraction from the α position by a factor of ~10 and the rate of addition to aromatic rings by a factor of ~5. Effects in aromatic and heterocyclic systems are, for the most part, relatively small (a factor of 1 to 3). Formic and barbituric acids are exceptional in that their rate constants for reaction with H atoms increase by two orders of magnitude with an increase in pH over the range of 1 to 7. The rate constant for reaction of H with OH^- was measured to be 1.5×10^7 M^{-1} sec^{-1}. (auth)

55879 POSSIBLE ROLE OF SINGLET OXYGEN IN AN ION-INDUCED REACTION MECHANISM OF NUCLEUS FORMATION BY SULPHUR DIOXIDE. Vohra, K. G.; Nair, P. V. N.; Muraleedharan, T. S. (Bhabha Atomic Research Centre, Bombay). J. Aerosol. Sci.; 3: No. 4, 225-36(Jun 1972).

A mechanism of conversion of small concentrations of SO_2 in the air to H_2SO_4 nuclei was investigated. SO_2 oxidation is first carried out by singlet excited molecular oxygen, probably $^1\Delta g$ state. The products of this reaction are converted to H_2SO_4 nuclei in the presence of water vapor and ionizing radiation. The production of singlet oxygen by photolysis of oxygen and ozone (formed during oxygen photolysis) is described. Experiments were carried out to study the variation in nucleus formation with varying concentrations of SO_2 and singlet oxygen and different values of ionization dose. The estimates of rate constant for SO_2 oxidation by singlet oxygen are presented. Based on the results of these preliminary experiments, the possible role of the mechanism in the atmosphere is discussed. (auth)

55880 ON THE MECHANISM OF H-ATOM FORMATION BY REACTION OF ELECTRONS IN FROZEN ACIDIC SOLUTIONS AT 77°K. Ohno, Shin-ichi; Sasaki, Teikichi; Koike, Mitsuru (Japan Atomic Energy Research Inst., Tokai). Bull. Chem. Soc. Jap.; 45: No. 8, 2383-5(Aug 1972).

A model for the reaction of radiation-produced electrons in frozen acidic solutions is presented to explain anomalies. It does not assume the inertness of the hydrogen ion as an electron scavenger in the solid phase but involves a process in which an H atom, the product of the $(e^- + H^+)$ reaction, is transferred to an adjacent water molecule through an H-bonded network until it finds a suitable site where it can be trapped or a species with which to react. Results from ESR measurements on photolysed frozen solutions of ferrocyanide ions in the presence of nitrate ions and 2-propanol as well as the data on H/D isotope effects were used as evidence supporting the model. (auth)

55881 BEHAVIOR OF POSITIVE HOLE IN A γ-IRRADIATED 3-METHYLPENTANE GLASS AT 77°K. Irie, Masahiro (Hokkaido Univ., Sapporo); Yoshida, Hiroshi; Hayashi, Koichiro; Okamura, Seizo. Bull. Chem. Soc. Jap.; 45: No. 8, 2347-9(Aug 1972).

In order to elucidate the behavior of a positive hole in irradiated alkane glasses, the effect of solutes having an ionization potential lower than that of a glass matrix molecule on the decay of a trapped electron was examined in a 3-methylpentane glass at 77°K by means of electron spin resonance. The decay was found to be explained in terms of the superposition of two exponentially decaying processes, as in the absence of a solute. Although the fast process was not affected by a solute, the slow process was further slowed by the addition of a solute. The effect of a solute is described by the empirical relation, $k/k_0 = 1/(1 + fN)$, where k and k_0 are the rate constants of the slow decay in the presence and in the absence of a solute, respectively. N is the mole fraction of a solute. The observed values of the slowing-down efficiency, f, increase in parallel with the decreasing values of ionization potential of solutes: 2-methyltetrahydrofuran, ethyl ether, methyl vinyl ether, 2-methylpentene-1 and n-butyl vinyl ether. The results are interpreted in terms of trapping of a positive hole by a solute molecule and positive hole tunneling from a hole trap to a trapped electron. (auth)

55882 ENERGY TRANSFER IN THE γ-IRRADIATED BENZENE SOLUTIONS OF CARBONYL SULFIDE, NITROUS OXIDE, AND CARBON DIOXIDE. Sato, Shin; Hosoya, Kiyoshi; Shishido, Seishi; Hirokami, Shun-ichi (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 45: No. 8, 2308-12(Aug 1972).

The γ radiolysis of benzene solutions containing carbonyl sulfide, nitrous oxide, and carbon dioxide was investigated at room temperature and at 0°C. Carbonyl sulfide was shown to be an effective electron scavenger and to give carbon monoxide as the product. By comparing the solute concentration dependences of $G(N_2)$ and G(CO), it was concluded that the collision of secondary electrons with benzene does not efficiently produce the first excited singlet state, the G-value of which is less than 0.2 if it is produced at all. The concentration dependences of the G(CO) and G(phenol) from the benzene solution of carbon dioxide also suggested that the superexcited state or the highly excited state of benzene is too short-lived to transfer its energy to the solute. (auth)

55883 RADIATION-INDUCED CYCLODIMERISATION OF CRYSTALLINE ACENAPHTHYLENE. Chapiro, A. (CNRS, Meudon, France); Lozach, G. Int. J. Radiat. Phys. Chem.; 4: No. 3, 285-309(Aug 1972). (In French).

The radiation chemical cyclodimerization of crystalline acenaphthylene is a slow reaction; at 20°C and for a dose of 100 Mrad 2.1% of transcyclodimer is formed, while concurrently an abundant polymerization occurs. The curves of the dimerization conversion follow the equation: percentage of conversion = k $(dose)^{1.26}$. The auto-acceleration of the reaction is accounted for by a modification (destruction) of the crystal lattice due to the polymer formation. This modification was proved by differential thermal analysis. Moreover, a NMR study revealed the appearance of molecular movements in irradiated acenaphthylene. The dimerization reaction is favored by an imperfect crystal lattice. Effects of different additives on the dimerization were studied. Acenaphthene accelerates the conversion to dimer without modifying the kinetic features of the reaction. This result shows the existence of an energy transfer from acenaphthene to acenaphthylene. The analysis of these results and of those obtained with other additives (stilbene, anthracene, oxygen) suggests that a triplet state of acenaphthylene is a precursor of the cyclodimerization. (auth)

55884 RADIOLYSIS OF ETHERS. 2. TRAPPING AND REACTIONS OF ELECTRONS AND FORMATION OF HYDROGEN IN GLASSY 2-METHYLTETRAHYDROFURAN. Teply, J. (Ceskoslovak Akademy of Sciences, Rez); Janovsky, I.; Kiss, F.;

Vacek, K. Int. J. Radiat. Phys. Chem.; 4: No. 3, 265-76(Aug 1972).

From the effects of γ-radiation dose, scavenger concentration, photobleaching and temperature on the yield of electrons and radicals trapped in glassy 2-methyltetrahydrofuran (2-MTHF) irradiated at 77°K, the spatial distribution of trapped electrons and radicals is considered. At doses around 4×10^{21} eV g^{-1} the electrons are scavenged efficiently by accumulated trapped radicals and ions. At higher doses newly formed radicals and ions react with remaining trapped electrons, the concentration of which thus tends to zero. The initial thermal decay of trapped electrons at 93°K is fast and its kinetics cannot be measured; this part of the electrons amounts to 30 to 60% of all trapped electrons; the remainder of the trapped electrons decays at low doses (10^{17} to 10^{19} eV g^{-1}) by second-order kinetics, which changes to first order at higher doses (1.2 to 1.6×10^{21} eV g^{-1}); this is accounted for by the change of a bimolecular reaction of electrons with radicals and ions to a pseudomonomolecular reaction due to the increase in trapped radical and ion concentrations. The electrons are not precursors of hydrogen; no protonated molecules or radicals are formed on irradiation. Hydrogen formation can be partly suppressed by scavengers of hydrogen atoms. The radiolysis mechanism is discussed. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 55817.

55885 PREPARATION OF A ^{99m}Tc LABELED IRON COMPLEX BASED DIAGNOSTIC SUBSTANCE. Nouel, J. P.; Renault, Henri (to Compagnie Francaise Philips). French Patent 2,088,149. 7 Jan 1972. Filed 22 May 1970. (In French)

The preparation of a diagnostic substance having a ^{99m}Tc labeled iron complex base is described; a Tc compound solution is added to ferrous ascorbate, the resulting solution is then alkalinized (pH between 7 and 8), and agitated until a violet coloration is obtained. The diagnostic kit is supplied in the form of a single package containing a flask of ferrous ascorbate and a syringe containing the alkalinizing solution. (France)

55886 COPRECIPITATION PROCESSES IN RADIOCHEMISTRY. Grebenshchikova, V. I. At. Energ. (USSR); 33: No. 2, 616-21(Aug 1972). (In Russian).

Some of the basic principles of coprecipitation procedures are discussed, with emphasis on the isomorphous character of a microelement, which is carried down with a macroelement. Khlopin's law of distribution $C_1/C_2 = K$ and its application are reviewed. The coprecipitation of heterovalent components was studied in some detail at the Institute and the laws that guide the process were utilized in analytical chemistry and the chemical technology of radioelements. (K.S.W.)

Hot-Atom Chemistry

Refer also to abstract 55820.

55887 (COO-3570-1) RESEARCH ON HIGH-ENERGY CHEMICAL REACTIONS. Annual Progress Report. Cross, R. J. (Yale Univ., New Haven, Conn. Dept. of Chemistry). Jul 1972. Contract AT(11-1)-3570. 5p. Dep. NTIS.

The research progress is reported in five areas: (1) studies of hot tritium reactions using nuclear recoil techniques, (2) measurements of the energy dependence of hot tritium reactions using molecular beams, (3) the determination of the structure of the benzene ion, (4) studies of ion-molecule reactions, (5) calculations on the reactions of the H_3^+ system. (auth)

55888 UNUSUAL ANNEALING OF NEUTRON-IRRADIATED SELENITES. Al-Siddique, F. R.; Maddock, A. G.; Palma, T. (Cambridge Univ., Eng.). J. Inorg. Nucl. Chem.; 34: No. 10, 3015-19(Oct 1972).

Radiative thermal neutron capture by an atom combined in an anionic species very seldom leads to an oxidized radioactive product. The products formed in irradiated hydrated or anhydrous sodium selenite comprise radioactive elemental selenium, selenite and selenate. Equally surprising, on thermal annealing, the proportion of zero-valent selenium decreases and that of selenate increases, while selenite is not much changed. Possible explanations of this unusual behavior are discussed. (auth)

55889 CHEMICAL CONSEQUENCES OF ION IMPLANTATION AND THERMAL NEUTRON CAPTURE IN ALKALI SELENATES. Cogneau, M.; Duplatre, G.; Vargas, J. I. (CEN, Grenoble, France). J. Inorg. Nucl. Chem.; 34: No. 10, 3021-6(Oct 1972).

The chemical forms of ^{75}Se, generated by thermal neutron irradiation and by implantation of $^{75}Se^+$ ions in K_2SeO_4 crystals kept at 77°K were studied. Whereas the initial distribution of activity in the implanted targets gave 56.3, 34.1, and 9.6% respectively for Se, Se(IV), and Se(VI), only Se(IV) (68.0%) and Se(VI) (32.0%) were detected in the neutron irradiated samples. Several first order annealing stages were found for both types of irradiation. The EPR study on the annealing of SeO_3^-, as well as the radiochemical results, suggest that the main species generated by neutron capture in the alkali selenates result from the loss of O^- rather than O^{2-} or O. The results on potassium and sodium selenates are compared with observations made in other systems. (auth)

55890 PRODUCTS OF PLUTONIUM DIOXIDE CHLORINATION IN MELTS OF ALKALI METAL CHLORIDES. Vorobei, M. P.; Skiba, O. V.; Blokhin, N. B.; Rykov, A. G. At. Energ. (USSR); 33: No. 1, 553-6(Jul 1972). (In Russian).

The valence states of plutonium formed during chlorination of PuO_2 by dry chlorine gas in the melts of alkali-metal chlorides were studied by spectrophotometry. The effects of temperature, concentration, nature of solvent-salt, and chlorination time on the stability, and the proportions of various valent forms of plutonium in the melt are shown. It is established that the plutonium in the melt may be in the trivalent, tetravalent, and hexavalent states in various proportions depending on the above factors. Reactions are suggested for the processes in chloride melts during the chlorination of plutonium dioxide. The equilibrium constant of the reaction was calculated. (auth)

55891 REACTIONS OF RECOIL CHLORINE ATOMS WITH CIS AND TRANS OLEFINS. Smith, W. S.; Daniel, S. H.; Tang, Yi-noo (Texas A and M Univ., College Station). Contract AT(40-1)-3898. J. Phys. Chem.; 76: No. 19, 2711-15(14 Sep 1972).

Reactions of recoil ^{38}Cl atoms with the cis and trans isomers of both 1,2-dichloroethylene and 2-butene were studied. The percentage absolute yield for the sum of the two isomeric products of the former system ranges from 7 to 31%, depending on scavenging efficiency, while that of the latter accounts for only about 0.5% of the total ^{38}Cl formed. The unequal trans/cis product branching ratio from the two geometric isomers of dichloroethylene prompts one to the conclusion that besides the usual addition—elimination reaction observed for Cl atom reactions, there is a certain contribution from a direct substitution process. The presence of the latter reaction is strongly supported by the 5 : 1 and 1 : 5 isomer branching ratio of products observed in cis- and trans-2-butene systems. The equilibrium product branching ratio from the addition—elimination process alone was demonstrated to be a function of the excitation energy of the decomposing radicals. (auth)

55892 SYSTEMATICS OF (n,γ)-ACTIVATED HOT ^{128}I REACTIONS IN GASEOUS METHANE AND HALOMETHANES. THE ENERGY DEGRADATION FACTOR. Yoong, Matthias; Pao, Y. C.; Rack, E. P. (Univ. of Nebraska, Lincoln). Contract AT(11-1)-1617. J. Phys. Chem.; 76: No. 19, 2685-9(14 Sep 1972). (COO-1617-30).

It was found in a systematic study of ^{128}I reactions activated by radiative neutron capture in various gaseous halomethanes that the formation of ^{128}I-labeled organic products proceeds entirely by hot (requiring excess kinetic energy to occur) reactions. This is unlike the reactions of ^{128}I with CH_4 where the organic product $CH_3{}^{128}I$ was formed not only by hot ^{128}I atoms but by thermal ion—molecule reactions involving I^+ in the $^1D_2$, $^3P_0$, $^3P_1$, and $^3P_2$ states. In the various halomethane systems only two ^{128}I-labeled organic products were found, those resulting from halogen and hydrogen substitution. The limiting ^{128}I organic yields in gaseous CH_3F, CH_3Cl, CH_3Br, and CH_3I were 11.2, 4.2, 0.67, and 0.20%, respectively. The kinetic energy spectra for (n,γ)-activated ^{128}I atoms or ions were calculated and the results showed that an appreciable fraction of the ^{128}I species are born with low kinetic energies, in or near the reactive zone. The only physical or chemical parameter that explained the trend in organic yields was the energy degradation factor of the halomethane system, correlating well with the kinetic energy spectrum of ^{128}I. (auth)

55893 COMPUTER SIMULATION OF HOT-ATOM CHEMISTRY. Malcolme-Lawes, D. J.; Urch, D. S. (Queen Mary Coll., London). J. Chem. Soc., Faraday Trans., II; 68: No. 6, 967-78(1972).

High energy atoms can lose energy in successive collisions with molecules or other atoms. At certain energies (above thermal) there may be the possibility of chemical reaction ("hot atom" reaction). A computer model is described which simulates this process. The probability of a hot atom of energy E reacting upon collision, is assumed to be a Gaussian function of E for simplicity. The possibility of a variety of products being formed is considered and the variation of the yields of "hot products" as a function of parameters such as the concentration of inert gas is also described. The model is also used critically to discuss the effectiveness of the Estrup–Wolfgang (J. Amer. Chem. Soc., 82, 2661, 2665, 1960) theory for the treatment of results from hot atom experiments. (auth)

55894 CHEMICAL EFFECTS OF THE (n,γ) REACTION IN ALKALI SELENATES. Al-Siddique, F. R.; Maddock, A. G. (Cambridge Univ., Eng.). J. Inorg. Nucl. Chem.; 34: No. 10, 3007-14(Oct 1972).

Thermal annealing isochronals were measured for sodium and potassium selenates. They are quite dissimilar. The isochronal for a dehydrated sample of irradiated sodium selenate hydrate suggests that dehydration removes the more readily annealable fragment centers. The temperature dependence of the radiation annealing of the same two salts was also explored. An explanation of this temperature dependence, which also accounts for various features of the isothermal radiation annealing process, is proposed. (auth)

55895 CONCERNING THE YIELD OF ETHYLENE-t FROM THE REACTION OF RECOIL TRITIUM WITH THE SYSTEM BUTENE-2 AND HELIUM. EVIDENCE FOR T^+, OR RADIATION DAMAGE? Johnston, A. J.; Urch, D. S. (Queen Mary Coll., London). Radiochem. Radioanal. Lett.; 11: No. 3-4, 171-5 (15 Sep 1972).

The yield (i.e., fraction of recoil tritium available for gas phase reaction) of labeled ethylene from the neutron-irradiated system trans-butene-2 and helium is indifferent to the mol. fraction of butene-2. The possibility that this result is due to T^+ is discussed but is rejected in favor of a mechanism based on radiation damage induced by recoiling tritons and protons. It was concluded that there is, as yet, no experimental evidence for T^+ participation in recoil tritium reactions, even at high helium concentrations. (auth)

55896 ^{18}F RECOIL LABELING. Lebowitz, E.; Richards, P.; Baranosky, J. (Brookhaven National Lab., Upton, N. Y.). Int. J. Appl. Radiat. Isotop.; 23: No. 8, 392-4(Aug 1972).

Efforts are underway to extend the usefulness of radioisotope scanning by labeling metabolites with short-lived isotopes such as ^{11}C, ^{18}F and ^{123}I. The use of ^{18}F makes synthesis and distribution studies easier than with ^{11}C, and F substitution produces a stronger bond and possibly less chemical modifications of the labeled compound than ^{123}I. Studies are described on the feasibility of labeling biological compounds with ^{18}F by recoil techniques. The method involves bombardment of a Ne gas target, whose walls are coated with the compound to be labeled, with Van de Graaff accelerated deuterons. The ^{18}F atoms produced by the reaction ^{20}Ne (d,α) ^{18}F recoil to the target walls and react with the compound to be labeled. By having the compound to be labeled in the solid phase, rather than a gas, higher yields are achieved and the radiation damage to the target compound and the product compound is minimized. Very high specific activity material can be produced; and the processing time is about 2 hr from the end of bombardment until the final product is ready for medical use. The effect of parameters such as target gas pressure, beam energy and beam current was evaluated. A study is being made of the use of ^{18}F-fluorouracil as a tumor localizing agent. A major disadvantage of the process is that so far only 1% labeling efficiency has been obtained. (UK)

55897 CHEMICAL EFFECTS OF NUCLEAR REACTIONS DUE TO THERMAL NEUTRONS. PART II. RECOMBINATION REACTIONS. Mahieu, B.; Apers, D. J.; Capron, P. C. (Laboratoire de Chimie Nucleaire, Heverlee, Belg.). Rev. Quest. Sci.; 143: No. 3, 335-47(1972). (In French).

The immediate condition of the atom that has captured a neutron and which for this reason has recoiled through the surrounding material is discussed for the case of crystalline solids. The theoretical indications obtained do not make it possible to determine with precision the nature of the recoil fragment but tend, however, to prove that it is found in an oxidation state near to zero and that it is stripped of all its ligands. After dissipation of the excess kinetic energy, the linkages can reform and stabilize the atom in the form of a new compound. An appropriate treatment, especially an increase in temperature, can facilitate the formation of new linkages and thus restore the recoil atom in an environment similar to that which it possessed at the start. (tr-auth)

Properties of Radioactive Materials

Refer also to abstracts 55647, 55800, 56487, 56513, and 56577.

55898 (KFK–1620) TEMPERATURE DEPENDENCY OF THE COMPLEX EQUILIBRIA OF TRANSPLUTONIUM ELEMENTS. Grigorescu-Sabau, Carmen Sybile (Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Radiochemie). Jun 1972. 49p. (In German). Dep. NTIS (U. S. Sales Only).

The temperature dependency of the complex formation reactions of Am(III), Cm(III), and Cf(III) with nitrilotriacetic acid (H_3NTE), iminodiacetic acid (H_2IDE), diglycolic acid (H_2DGS), and thiodiglycolic acid (H_2TDG) was investigated. A special, not yet understood, temperature dependency of the stability constants was found by ion exchange. The stability constants seem to be greatly influenced by secondary reactions in the system, ion exchange resin–complex reagent solution. The secondary reaction is thought to be a temperature-dependent change of hydration of the sorbed species. The complex reactions of Am(III) were investigated in the region 15°C to 50°C by spectrophotometric measurements. Thermodynamic data of the identified complexes are tabulated. (auth)

55899 (LA–2559) CHEMICAL METHODS FOR PREPARATION OF COMBINATIONS OF MOLYBDENUM, TUNGSTEN, AND URANIUM OXIDES. Hayter, S. W. (Los Alamos Scientific Lab., N. Mex.). May 1961. Contract W-7405-eng-36. 21p. Dep. NTIS.

Procedures were developed for the simultaneous precipitation of molybdenyl uranyl oxinates, tungstyl uranyl oxinates, and molybdenyl tungstyl uranyl oxinates, all in a variety of compositions. The precipitation of uranyl polymolybdates and uranyl polytungstates was examined. Calcination of these various precipitates resulted in intimately mixed oxides, which could be reduced with H_2 to metal–UO_2 powders. (auth)

55900 (NIRS-Pu–7, pp 50-3) DETERMINATION OF PARTICLE SIZE OF Pu BY DIFFUSION CHAMBER. Matsuoka, Osamu; Joshima, Hisamasa (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

A method of particle-size determination for plutonium in solution is proposed. The diffusion chamber was prepared from a plastic ring (20 mm $\phi \times 5$ mm), both sides of which were covered with Millipore membrane of adequate pore size of Visking membrane. The diffusion chamber containing 0.1 ml of test solution was placed in a plastic container with 5 to 10 ml saline solution and incubated 1 hr with shaking in 37°C water bath. The "diffusibility" of plutonium particles from the diffusion chamber was estimated from the sample measurement of extra fluid at the final point by liquid scintillation counting and/or external counting at 17 keV L-Xray of the diffusion chamber before and after the incubation. The particle size of "Monomeric" and "Polymeric" plutonium was estimated by this method. This technique may be useful in future studies of the effect of chelating agents on plutonium in vitro. (auth) (Japan)

55901 (ORNL–TM–3817) HTGR FUEL DEVELOPMENT: USE OF UO_3 TO LOAD CATION EXCHANGE RESIN FOR MICROSPHERE PREPARATION. Haas, P. A. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 39p. Dep. NTIS.

Coated particles made from ion exchange resins offer an attractive alternative to "fissile" particles specified for advanced HTGR's. The concept of reacting cation exchange resins in the hydrogen form with UO_3, using dilute uranyl salt solutions as a transfer medium, has important advantages for preparation of HTGR fuel particles from ion exchange resins. Dowex 50W-X8 (with nuclear sulfuric acid exchange groups attached to a styrene-divinylbenzene polymer lattice) satisfies the product requirements better than do other strong acid resins, but the sulfuric acid exchange group leaves sulfur in the carbonized particle. Weakly acidic cation exchange resins with carboxylic acid exchange groups leave only carbon and oxygen after carbonization and thus give particles more comparable with the UC_2 or UO_2 commonly used for HTGR fuels. Amberlite IRC-72 was identified as having a better combination of properties than any other weak acid resin tested. The procedure of reacting UO_3 with cation exchange resins in the hydrogen form using uranyl nitrate as the transfer solution allows efficient and well-controlled loading of either strong or weak acid resins without formation of dilute uranium solution. The final solution concentration can be selected and controlled by mixing the desired amounts of UO_3, resin, and solution without any need to monitor flow rates or concentrations. Mixing of UO_3 with the resin is the only procedure that has demonstrated practical, stoichiometric loadings of a weak acid resin with uranium. Satisfactory mixing of resins, UO_3, and uranyl nitrate solution was demonstrated in agitated baffled vessels, in a screen-bottom basket of the resin-in-pulp type of contactor, and in a fluidized resin bed with a separate mixer for the addition of UO_3. (auth)

55902 (UCRL-Trans–10641) PREDICTION OF THE REDOX PROPERTIES OF THE SUPERHEAVY 8s, 7p, AND 6d ELEMENTS. David, F. ([Paris Univ., Orsay (France)]. Institut de Physique Nucleaire). Translated for Univ. of California, Lawrence Livermore Lab., Livermore, from report RC–71-06. 29p. Dep. NTIS.

A study of the thermodynamic properties of known elements of the s, p, and d series and their extrapolation made it possible to evaluate the free enthalpies of oxidoreduction for the "superheavy" 8s, 7p, and 6d elements. The validity of the predictions depends essentially on two conditions: similar variation of ΔG^0_I and ΔG^0_H with atomic number and on the exactness of the values adopted for ΔG^0_S, ΔG^0_I, and ΔG^0_H and for ΔG^0 for the known elements. Results indicated that the $8s^1$ and $8s^2$ elements probably have the properties predicted for the alkaline and alkaline earth elements, and that the elements of the 7p series would see their lower degrees of oxidation stabilizing in accordance with the general behavior of the properties of the known p-elements. (M.C.G.)

55903 CRYSTAL STRUCTURE OF AMERICIUM SULFATE OCTAHYDRATE. Burns, John H.; Baybarz, Russell D. (Oak Ridge National Lab., Tenn.). Inorg. Chem.; 11: No. 9, 2233-7(Sep 1972).

The structure of $Am_2(SO_4)_3 \cdot 8H_2O$ was determined by single-crystal x-ray diffraction methods. All nonhydrogen atomic positions were deduced from 3035 diffractometer-measured intensities by means of Patterson and Fourier methods. Refinement by the method of least squares with anisotropic thermal motion for each atom resulted in an agreement index, R_F, of 0.035. The monoclinic unit cell has dimensions of a = 13.619 (7), b = 6.837 (2), c = 18.405 (4) Å, and β = 102° 40 (5)'; it contains four formula units. The space group is C2/c. Each americium atom is coordinated by four oxygen atoms belonging to sulfate ions at 2.382 to 2.509 Å and by four water molecules at 2.406 to 2.553 Å. These eight oxygen atoms form a polyhedron which is intermediate between an antiprism and a dodecahedron. Cross-linking of americium atoms occurs through sharing of sulfate ions, and extensive hydrogen bonding involving the water molecules is indicated. (auth)

55904 DIPOLE TRANSITION MOMENTS OF MOLYBDATE ION, PERTECHNETATE ION, AND RUTHENIUM TETROXIDE. Tandon, S. P.; Surana, S. S. L. (Univ. of Jodhpur, India). J. Inorg. Nucl. Chem.; 34: No. 10, 3089-96(Oct 1972).

A LCAO-MO calculation was performed to calculate the values of both the dipole length ($Q^L_{theor.}$) and dipole velocity ($Q^V_{theor.}$) transition moments of the lowest energy $t_1 \rightarrow 2e(^1A_1 \rightarrow {^1T_2})$ transition for the isoelectronic tetroxy anions (MoO_4^{2-}, TcO_4^- and RuO_4) of the second transition metal series in terms of a single parameter β, the ligand mixing coefficient using STO's and more exact AO's derived by Basch and Gray (1966) to duplicate as nearly as possible the SCF AO's. All contributions from charge transfer integrals, one-center ligand integrals and two-center ligand integrals were considered. The use of dipole velocity operator leads to better results than those of the dipole length operator. As a by-product based on simplifying assumptions, the pertechnetate ion appears to possess less π-bonding than ruthenium tetroxide and molybdate ion has the least π-bonding. (auth)

55905 EFFECT OF RADIATION ON THE SELECTIVITY OF CATALYSTS. Spitsyn, Vikt. I.; Vol'kenshtein, F. F.; Pirogova, G. I.; (and others) (Inst. of Physical Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 4, 771-7(Apr 1972). (In Russian).

The catalyzed decomposition of 2-propanol was investigated using a Y_2O_3 catalyst containing ^{91}Y ($T_{1/2}$ = 57.3 days), in consideration of the two possible product pairs: acetone + H_2 vs propene + H_2O. The dehydrogenation rate increased with increase of specific radioactivity of the catalyst, while the reaction rate of dehydration decreased. Contact potential differences were measured and were related to the ratio: electron concentration/hole concentration; this ratio increased in proportion to the radioactivity of the sample. (K.S.W.)

55906 REACTIONS OF THE HEXAFLUORIDES OF Mo, W, AND U WITH ACETIC AND TRIFLUOROACETIC ACIDS. Nikolaev, N. S.; Kharitonov, Yu. Ya.; Sadikova, A. T.; Rasskazova, T. A.; Kozorezov, A. Z. (Inst. of General and Inorganic Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 4, 757-64(Apr 1972). (In Russian).

The hexafluorides of Mo, W, and U react with anhydrous acetic acid with gentle evolution of heat (warming to ~50°C) to form $MoOF_4$, WO_2F_2, and UO_2F_2. In the presence of alkali metal fluorides complex compounds form as follows: $KMoO_2F_3$ and $K_2MO_2F_4$ (M = W or U). UF_6 reacts with anhydrous F_3CCOOH to form HUF_6. In the presence of MF, $CF_3COOM \cdot 2UF_5$ is formed (M = Li, Na, K, Rb, Cs). The latter salts were subjected to thermogravimetric analysis. (K.S.W.)

55907 CRYSTAL STRUCTURE OF LITHIUM TRIURANATE. Kovda, L. M. (Moscow State Univ.). Zh. Strukt. Khim.; 13: No. 3, 458-60(1972). (In Russian).

The structure of lithium triuranate was partially determined by powder diffraction methods. The sample of $Li_2U_3O_{10}$ was synthesized by sintering together stoichiometric quantities of lithium carbonate and uranium oxide in air at 750°C. In contrast to the structure of the majority of polyuranates, it is not stratified. The basic structure consists of a three-dimensional arrangement of the groups U—O—U—O—U. Coordinates were recorded for each Li, U, and O atom in the molecule. (K.S.W.)

55908 CRYSTAL STRUCTURE OF $K_2U_7O_{22}$. Kovba, L. M. (Moscow State Univ.). Zh. Strukt. Khim.; 13: No. 2, 256-9 (1972). (In Russian).

Powder diffraction methods furnished data for a structure determination of $K_2U_7O_{22}$: rhombic cells a = 6.945, b = 19.533, c = 7.215 Å; density = 7.1. Atoms of K and additional UO_2 groups were sandwiched between infinite layers of $(UO_2)_5O_8$. The compound was prepared by sintering together stoichiometric amounts of K_2CO_3 and $UO_4 \cdot nH_2O$. (K.S.W.)

55909 DISSOCIATION ENERGIES FOR GASEOUS METAL DICARBIDES. Filby, E. E.; Ames, L. L. (New Mexico State Univ., Las Cruces). Inorg. Nucl. Chem. Lett.; 8: No. 10, 855-60(Oct 1972).

The "pseudo-oxide" hypothesis proposed by Chupka (J. Phys. Chem. 62: 611(1958)) and extended by DeMaria (J. Chem. Phys. 50: 1969(1969); 51: 2871(1969); 51: 2876(1969)) and the analogous pseudo-chalcogenide hypothesis were applied to metal dicarbides. Data are given for gaseous rare earth carbide molecules and for uranium carbide molecules. (UK)

55910 BEHAVIOR OF URANIUM COMPOUNDS ON HEATING: THERMAL DECOMPOSITION OF AMMONIUM URANATES. Spacu, P.; Cismaru, G. D. (Centre of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 17: No. 6, 947-59(Jun 1972).

The behavior of ammonium uranates on heating between 25 and 1100°C was studied in air, argon, and hydrogen. In air and in argon, the weight loss, until formation of U_3O_8, takes place in 4 stages, while in hydrogen, till formation of UO_2, it occurs in 5 stages. The influence of the H_2O/UO_3 ratio increase on the thermogram was determined. The most probable formula for ammonium uranates was established as being $[(UO_2)_m(OH)_{2(m-n)}(ONH_4)_{2n}(H_2O)_{(m-n)}](p-n)\ H_2O$. (auth)

55911 REDUCTION OF EINSTEINIUM AND CALIFORNIUM CHLORIDES TO THE DIVALENT STATE IN AQUEOUS ETHANOLIC SOLUTIONS. Mikheev, N. B.; Spitsyn, V. I.; Kamenskaya, A. N.; (and others) (Inst. of Chemical Physics, Moscow). Inorg. Nucl. Chem. Lett.; 8: No. 10, 869-73(Oct 1972).

It was necessary to find a system in which a high reduction potential could be created, divalent forms of the actinides stabilized, with reliable identification of the M^{2+} state of the actinides when present in micro amounts. These requirements were met by simultaneous reduction of Sm chlorides and the actinides with Mg metal in aqueous ethanolic solutions, the $SmCl_2$ formed carrying the divalent actinides. The co-crystallisations of Es and Cf with $SmCl_2$ is due to true isomorphism. (UK)

55912 CHEMISTRY OF URANIUM. Pt. 6. PENTAKIS(HEXAMETHYLPHOSPHORAMIDE)URANIUM(IV) PERCHLORATE. Du Preez, J. G. H.; Rohwer, H. E. (Univ. of Port Elizabeth, S. Afr.). Inorg. Nucl. Chem. Lett.; 8: No. 10, 921-5(Oct 1972).

The preparation and some properties of what is believed to be the first reported pentacoordinated U(IV) complex are described. This complex has the formula $U(ClO_4)_4 \cdot 5HMPA$, where HMPA is hexamethylphosphoramide. The compound is stable with respect to auto-oxidation if kept in a relatively dry atmosphere at room temperature and is only slightly hygroscopic. Details are given of molar conductivity, infrared spectra and electronic spectra. X-ray crystal structure determinations are being undertaken. (UK)

55913 INVESTIGATION OF THE URANIUM HEXAFLUORIDE–ANTIMONY PENTAFLUORIDE SYSTEM. Ezhov, V. K. Zh. Neorg. Khim.; 17: No. 7, 2043-5(Jul 1972). (In Russian).

Solid-liquid and liquid-vapor equilibria diagrams were constructed for the binary system UF_6-SbF_5. Melting point diagrams were constructed for the additional binary systems: UF_6-TaF_5, UF_6-UF_3, MoF_6-SbF_5. VF_5 exhibited a tendency to polymerize in the UF_6-VF_5 system. Comparisons were made with similar binary systems. (K.S.W.)

55914 PHASE EQUILIBRIUM DIAGRAM OF THE URANYL FLUORIDE–WATER SYSTEM. Tsvetkov, A. A.; Seleznev, V. P.; Sudarikov, B. N.; Gromov, B. V. (Moscow Inst. of Chemical Tech.). Zh. Neorg. Khim.; 17: No. 7, 2020-3(Jul 1972). (In Russian).

In a re-investigation of the $UO_2F_2-H_2O$ system the four hydrate regions were more accurately defined: $UO_2F_2 \cdot 4H_2O$, $UO_2F_2 \cdot 3H_2O$, $UO_2F_2 \cdot (1.6\ \text{to}\ 2.5)H_2O$, and $UO_2F_2 \cdot (0.8\ \text{to}\ 1.4)H_2O$. The enthalpy and free energy changes of seven step-wise dissociation reactions of the hydrates (to eventually yield UO_2F_2) were calculated. Similarly, the heats and free energies of formation of four hydrates of uranyl fluoride were computed. (K.S.W.)

55915 FORMATION CONSTANTS FOR THE MIXED-METAL COMPLEXES BETWEEN INDIUM(III) AND URANIUM(VI) WITH MALIC, CITRIC, AND TARTARIC ACIDS. Markovits, G.; Klotz, P.; Newman, L. (Brookhaven National Lab., Upton, N. Y.). Inorg. Chem.; 11: No. 10, 2405-8(Oct 1972).

Formation constants were determined for the mixed-metal complexes between indium(III) and uranium(VI) with malic, citric, and tartaric acids. In the cases of malic and tartaric acids the equilibrium can be written as $UO_2^{2+} + In^{3+} + 2H_3L = UO_2InL_2^- + 6H^+$. The logarithms of the equilibrium constants are −7.62 for the malate system and −7.14 for the tartrate. In the case of citric acid the equilibrium is $UO_2^{2+} + In^{3+} + 2H_4L = UO_2InL_2^{3-} + 8H^+$ where two of the protons come from the hydroxy groups. The logarithm of the constant is −11.58. Infrared measurements on trilaurylamine extracts of the mixed-metal complexes were made and are discussed. The dimerization constant for the formation of (uranyl citrate)$_2$ was determined potentiometrically and found to agree with the literature values. However, arguments are presented for the necessity of recalculating the values presented in the literature for the equilibrium $UO_2^{2+} + H_3L = UO_2L^- + 3H^+$. The logarithms of the recalculated values are −7.40 for malate, −6.30 for citrate, and −6.85 for tartrate. (auth)

55916 STRUCTURE AND DYNAMICS IN METAL TETRAHYDROBORATES. II. VIBRATIONAL SPECTRA AND STRUCTURES OF SOME TRANSITION METAL AND ACTINIDE TETRAHYDROBORATES. Marks, Tobin J.; Kennelly, William J.; Kolb, John R.; Shimp, Lawrence A. (Northwestern Univ., Evanston, Ill.). Inorg. Chem.; 11: No. 10, 2540-6(Oct 1972).

Vibrational spectroscopy allows a reasonably unambiguous distinction to be made between monodentate, bidentate, and tridentate hydrogen-bridged metal-BH_4 interactions for covalent organo-transition metal and -actinide tetrahydroborates. The following compounds have bidentate structures: $(h^5\text{-}C_5H_5)_2Ti(BH_4)$, $(h^5\text{-}C_5H_5)_2Zr(BH_4)_2$, and $(h^5\text{-}C_5H_5)_2Zr(H)(BH_4)$; the organoactinides $(h^5\text{-}C_5H_5)_3U(BH_4)$ and $(h^5\text{-}C_5H_5)_3Th(BH_4)$ have tridentate geometries. Data on these systems can be understood in terms of analogies with other organometallic systems (π-allyls). The synthesis of $(h^5\text{-}C_5H_5)_3Th(BH_4)$ is also reported. (auth)

55917 ISOCITRIC COMPLEXES OF TETRAVALENT PLUTONIUM. Metivier, H. (CEA, Montrouge, France); Guillaumont, R. Radiochem. Radioanal. Lett.; 11: No. 3-4, 165-9 (15 Sep 1972). (In French).

Complexing of Pu/IV/ with citric and isocitric acid is compared. Above pH 4.5 and b_{H_3cit} or $b_{H_3isocit}$ ~ 10^{-4}M, similar species occur in solution: $PuOcit_2^{4-}$ or $PuOisocit_2^{4-}$. (auth)

55918 TETRAVALENT STATE OF PLUTONIUM DURING HYDROLYSIS. Davydov, Yu. P. (Inst. of Nuclear Energy, Minsk). Dokl. Akad. Nauk BSSR; 16: No. 6, 524-7(Jun 1972). (In Russian).

The two methods used in this study of the tetravalent state of Pu consisted of ion exchange and absorption spectrum measurements conducted on solutions 1.0×10^{-6} M in concentration. From the change in optical density with changes in H^+ the two hydrolysis constants (stability constants for hydroxy-complexes) were derived: $K_1 = 2.7 \times 10^{-2}$, and $K_2 = 2.0 \times 10^{-2}$. (K.S.W.)

55919 EXPERIMENTAL DETERMINATION OF HYDROLYSIS CONSTANTS OF POLYVALENT ELEMENTS. Davydov, Yu. P. (Inst. of Nuclear Energy, Minsk). Dokl. Akad. Nauk BSSR; 16: No. 7, 620-2(Jul 1972). (In Russian).

The possibility of determining the equilibrium constant for the reaction: $Me^{n+} + mH_2O \rightleftharpoons Me(OH)_m^{n-m} + mH^+$ is discussed, with special reference to the stepwise formation of the following ligands: Pu^{4+}, $Pu(OH)^{3+}$, $Pu(OH)_2^{2+}$, and $Pu(OH)_3^+$, and a similar series of Po ions. (K.S.W.)

55920 FISP: COMPREHENSIVE COMPUTER PROGRAM FOR GENERATING FISSION PRODUCT INVENTORIES. Clarke, R. H. (Central Electricity Generating Board, Berkeley, Eng.). Health Phys.; 23: No. 4, 565-72(Oct 1972).

An account is given of the FISP program which produces number densities and activities of fission products for any type of reactor fuel after any irradiation history, together with β-heating within the fuel and multigroup γ-spectra for shielding calculations. The program considers all the radioactive and stable nuclides between ^{72}Zn and ^{161}Dy, their yields being tabulated for thermal and fast fission in ^{235}U, ^{239}Pu, and ^{241}Pu and for fast fission in ^{238}U. The program uses several novel features in the evaluation of the fission product inventory which make it extremely fast and simple to use. FISP is written in Fortran IV (H) and takes about 0.4 sec/case on the IBM 360/85 computer. The program is in use with the U.K.A.E.A. and Design Companies in the United Kingdom as well as the Central Electricity Generating Board. (auth)

55921 COMPOSITION OF URANYL BENZOATE AND COMPLEXES WITH CERTAIN DYESTUFFS. Tarayan, V. M.; Ovsepyan, E. N.; Petrosyan, A. A. (Erevan State Univ.). Dokl. Akad. Nauk Arm. SSR; 53: No. 5, 264-8(1971). (In Russian).

A study was made of the molar ratio of components in several uranyl benzoate complexes with the following dyes: dimethylthionine, trimethylthionine, tetramethylthionine, Methylene Green, Acridine Orange NO, and Toluidine Blue. Using an equilibrium displacement method, it was established that the anion complex formed had the composition $[UO_2(C_6H_5COO)_3]^-$, or where chloride ion was present: $[UO_2Cl(C_6H_5COO)_2]^-$. (K.S.W.)

55922 SOME PROPERTIES OF HEPTAVALENT PLUTONIUM IN MOLTEN KOH–NaOH EUTECTIC. Martinot, L.; Duyckaerts, G. (Univ., Liege). Inorg. Nucl. Chem. Lett.; 8: No. 10, 861-7(Oct 1972).

Studies are reported on the electrochemical reduction of PuO_5^{3-} in molten KOH–NaOH at 240°C. The reduction proceeded in two steps, the second of which is rate determining, $PuO_5^{3-} + e^- \rightarrow PuO_2^{2+} + 30^{2-}$ and $PuO_2^{2+} + 2e^- \rightarrow PuO_2$. Pu(VII) solutions were easily prepared by dissolving Na_3PuO_5 in the melt, but the short life of Pu(VII), however, allowed only qualitative study. The Na_3PuO_5 was obtained by heating together PuO_2 and Na_2O_2 at 420°C in pure O_2 flow. The stability of Pu(VII) is inferior to that of Np(VII) in a KOH–NaOH melt at 240°C, and spontaneous reduction of Pu(VII) gives only Pu(VI) as a reaction product. (UK)

55923 INFLUENCE OF THE ORGANIC REACTANT ARSENAZO III ON HYDROLYTIC EQUILIBRIUM IN SOLUTION. Davydov, Yu. P. (Inst. of Nuclear Energy, Minsk). Dokl. Akad. Nauk BSSR; 16: No. 4, 332-4(Apr 1972). (In Russian).

The rate of decomposition of a hydrolyzed form of tetravalent plutonium was studied in the presence of Arsenazo III. The monomer of the hydrolyzed form of Pu(IV) decomposed in somewhat over one hour; in the case of the polymeric form no displacement of the steady-state equilibrium could be observed in the one hour of observation. The general use of organic reagents in studying hydrolytic equilibria in solution is discussed. (tr-auth)

55924 PREPARATION OF PLUTONIUM(III) FORMATE. Crisler, L. R. (Dow Chemical Co., Golden, Colo.). J. Inorg. Nucl. Chem.; 34: No. 10, 3263-6(Oct 1972).

Plutonium(III) formate was prepared by the reaction of plutonium(III) hydroxide with formic acid. Characterization and identification were accomplished by elemental analyses, thermogravimetric analysis, x-ray powder diffraction, and ir spectroscopy. (auth)

55925 COMPLEX FORMATION OF THORIUM WITH XYLENOL ORANGE PHOTOMETRIC INVESTIGATION OF MH_jL_n AND MH_hL_{n+1} SYSTEMS. Budesinsky, B. W. (Univ. of Arizona, Tucson); Svec. J. Anal. Chim. Acta; 61 No. 3, 465-73(Oct 1972).

A procedure is described for photometric investigations of systems of two metal– Ligand complexes where the ligand is absorbing and polydentate. The procedure was used to study the complex formation between thorium and xylenol orange. The complexes of ThH_2L, ThH_4L_2, and Th_2H_2L were found with logarithmic overall stability constants of 34.93 ± 0.08, 64.47 ± 0.09, 39.25 ± 0.11, and molar absorptivities of 38,950 ± 410, 62,630 ± 820 and 44,830 ± 980 cm^2 mmole^{-1} (for 570 nm), respectively. (auth)

55926 TECHNETIUM CHLORIDES AND OXOCHLORIDES. Guest, A. (Univ. of West Indies, Mona, Jamaica); Lock, C. J. L. Can. J. Chem.; 50: No. 12, 1807-10(15 Jun 1972).

Attempts to prepare $TcCl_6$ by the method published previously were unsuccessful even though the reaction between Tc and Cl_2 gave products which appeared the same. TcO_3Cl and $TcOCl_4$ were prepared and fully characterized for the first time. (auth) (Canada)

55927 THERMODYNAMICS OF THE FORMATION OF IRON(III) AND URANIUM(VI) CHELATES WITH 2-HYDROXY-1-NAPHTHOIC ACID. Pant, A. N.; Soni, R. N.; Gupta, S. L. (Birla Inst. of Tech. and Science, Pilani, India). J. Inorg. Nucl. Chem.; 34: No. 9, 2951-3(Sep 1972).

In the course of an investigation of 2-hydroxy-1-naphthoic acid, it was observed that uranium(VI) and iron(III) develop orange and bluish black complexes in alcoholic medium. The thermodynamic stability constant and thermodynamic functions for these chelates are reported. (auth)

Radioactive Waste Treatment

Refer also to abstracts 55777, 58095, and 58119.

55928 (ARH–2343) HYDROFLUORIC ACID SCRUBBER SYSTEMS. Panesko, J. Vincent (Atlantic Richfield Hanford Co., Richland, Wash.). Jun 1972. Contract AT(45-1)-2130. 8p. Dep. NTIS.

Caustic or aluminum scrubber solutions remove hydrogen fluoride from off-gas streams. Solids which appear with aluminum could be avoided by heating the scrubber solution. (auth)

55929 (BNWL–1666) WASTE SOLIDIFICATION PROGRAM. VOLUME 10. EVALUATION OF SOLIDIFIED WASTE PRODUCTS. Mendel, J. E.; McElroy, J. L. (Battelle Pacific Northwest Labs., Richland, Wash.). Jul 1972. Contract AT(45-1)-1830. 134p. Dep. NTIS.

Demonstrations of the solidification of high level radioactive wastes were successfully conducted on an engineering scale in the Waste Solidification Engineering Prototypes (WSEP) at the Pacific Northwest Laboratory. The processes demonstrated in the WSEP produced highly radioactive solidified waste in the form of (1) oxide calcine, (2) phosphate microcrystalline ceramic, (3) phosphate glass, and (4) borosilicate glass. A total of 4930 kg of solidified waste, containing 51,800,000 curies initially, was encapsulated in 33 containers (pots). The mild steel, 304L, and 310 stainless steel pots containing the solidified wastes, each 8 feet long, range from 6 to 12 inches in diameter, and are very representative of the solidified waste pots that will be produced by power reactor fuel reprocessors for many years to come. Nominal fission product oxide content of the solids ranges from 9 to highs of 47 and 82 wt.% in glass and calcine products, respectively. The pots containing the solidified wastes have now been in interim storage from 2 to 6 years. Currently 23 are in air at ambient temperature, and 10 in the Solids Storage Engineering Test Facility (SSETF) in air or water at controlled temperatures. An evaluation program is being conducted to measure the properties of the highly radioactive solidified wastes during interim storage and to compare the properties with those measured on laboratory-prepared, nonradioactive solids of comparable chemical composition. Properties being measured include pot pressurization and corrosion, and solidified product homogeneity, leachability, thermal conductivity, and dispersibility. Properties of the highly radioactive products were found to be substantially those predicted from nonradioactive studies. (auth)

55930 (BNWL-tr–74) MELTING OF RADIOACTIVE CONCENTRATES IN GLASS OR CERAMIC SUBSTANCES. SECOND COMMUNICATION: SUITABILITY INVESTIGATIONS OF POROUS DOMESTIC STONES. Sachse, G.; Rosenberger, H. Translated for Battelle Pacific Northwest Labs., Richland, Wash., from Kernenergie; 10: No. 11, 344-9(1967). 16p. Dep. NTIS.

The characteristics of domestic porous stones, especially plastic clays of varying composition and decay products of syenite and paleozoic slate, as well as a potter's clay, are described. Special attention is given to the sintering or melting behavior, the grain composition, the gel formation capacity with acids, and the development of hydrolytically constant ceramic bodies from the porous stones investigated with addition of inactive mixing components. The selection of suitable raw materials for the fixation of radioactive concentrates for the purpose of final storage was the objective of the study. The soluble activity portion of radioactive melting or sintering bodies was determined by a simple comparison method. From among a total of 30 raw materials, 14 of which were investigated more thoroughly, 4 samples displayed good-to-excellent characteristics from a melting-technique point of view as well as with respect to their retention capacity. (auth)

55931 (DOCKET-50201–131) WEST VALLEY REPROCESSING PLANT. Low Level Liquid Waste Treatment Facility, Summary Report No. 8. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 15 Sep 1972. 28p. Dep. NTIS.

Plant performance and development work on the low-level liquid waste treatment facility are summarized. All waste water from the processing plant, except the laundry and condensate was processed. ^{90}Sr concentrations in composited samples are shown, along with ^{137}Cs concentrations in the plant feed and effluent. Removal factors for ^{106}RuRh were lower than the previous reporting period, supporting the observation that the ruthenium in fresh reprocessing waste is more easily removed than that in aged waste. The most significant factor affecting service life of the ion exchangers was found to be the feed sodium concentration. The best guideline for CS–100 resin performance is the moisture retention. Data are presented in tables and graphs. (M.C.G.)

55932 (NIRS-Pu–7, pp 75-7) EXPERIMENTAL RESEARCH ON FLOCCULATION OF LOW LEVEL RADIOACTIVE EFFLUENT TREATMENT. III. Ohyama, Ryutaro; Yoshikawa, Kikuo; Sumita, Hiromu (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

Experiments were performed to investigate the effects of the kind of coagulant and the amount used on flocculation of radioactive effluent containing an α emitter such as ^{239}Pu or U. The coagulants used were Na_3Po_4 with $CaCl_2$, $CuSO_4$, and $Fe_2(SO_4)_3$ with NaOH. Tested solutions contained ^{239}Pu (9×10^{-5} μCi/ml) or U (42 μg/ml) in tap water. Cupric hydroxide flocculation of 200 ppM was found most effective for ^{239}Pu(98% decontamination rates) and for U (97.5%). The decontamination rate of ^{239}Pu and U was about 90% when the following coagulants were used: ^{239}Pu: $CuSO_4$ 35 ppM, $Na_3PO_4-CaCl_2$ 20 ppM, $Fe_2(SO_4)_3$ 80 ppM and U: $CuSO_4$ 15 ppM, $Fe_2\ (SO_4)_3$ 125 ppM. (Japan)

55933 TRITIATED WATER RECOVERY SYSTEM. Stewart, M. L.; Kline, J. R.; Jordan, C. F. (Argonne National Lab., Ill.). Int. J. Appl. Radiat. Isotop.; 23: No. 8, 387-8(Aug 1972).

Improved equipment is described that was developed and used successfully in the extraction of HTO from various kinds of samples by freeze drying. The basic features are (1) simplicity of the glassware, (2) ease of operation, (3) application to a wide range of sample types and sizes; (4) the large number of samples that can be processed simultaneously; and (5) low cost. Samples varying in water content from 10 ml to <0.1 ml were freeze dried successfully, and an investigator could easily process up to 35 samples per day. The cost of a completed freeze-dry tube is estimated at about 20.00 dollars (USA). (UK)

55934 DECONTAMINATION FACILITY FOR RADIOACTIVE WASTE WATER. Kieschnick, E.; Luh, K. H. (to BAMAG Verfahrenstechnik GmbH). German Patent 1,584,977. 13 Jan 1972. (In German).

Object of the invention is a facility for the decontamination of radioactive waste water by allowing the waste to decay and, if necessary, subsequent dilution with water. It consists of pressure-proof decay containers and several pressure-proof intermediate containers which prevent reverse flow, as well as of all ducts and several armatures required for inlet and outlet, recirculation, mixing and dilution of the radioactive waste waters, and for removing the sludge from the containers. It further includes auxiliary equipment for sampling, control and measurements. (GF)

Radioisotope Production

Refer also to abstract 56518.

55935 (DP–1299) DENITRATION OF NITRIC ACID SOLUTIONS BY FORMIC ACID. Bradley, R. F.; Goodlett, C. B. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). June 1972. Contract AT(07-2)-1. 45p. Dep. NTIS.

A process was developed to reduce the nitric acid concentration of ion exchange feed solutions to <1M by metering in formic acid to react with the nitric acid and form gases and water. Pressure surges are eliminated by allowing only a small amount of formic acid to accumulate in the system before the reaction initiates. The nitric acid solution is heated to >90°C before formic acid addition begins, and the reaction is carried out under reflux. Laboratory tests were made to define the operating conditions of the denitration reaction and to develop mathematical models of the reaction behavior. Full-scale tests were then carried out with 10-l batches of nitric acid in prototype equipment to demonstrate that the reaction could be carried out accurately and safely and to define the operating characteristics of the equipment. (auth)

55936 PRODUCTION OF PURE AMERICIUM AND CURIUM THROUGH DISSOCIATION OF INTERMETALLIC COMPOUNDS. Mueller, W.; Reul, J.; Spirlet, J. C. (Europaeisches Institut fuer Transurane, Karlsruhe, Ger.). Atomwirt., Atomtech.; 17: No. 8, 415-16(Aug 1972). (In German).

From the vacuum thermolysis of four grams of Pt_5Am at 1550°C under 10^{-6} torr, 88% of the americium was evaporated. The metal, condensed at 900°C, was repeatedly subjected to further purification through sublimation at 1100°C. The metal contained less than 0.1% of metallic impurities as confirmed by emission spectroscopy and mass spectroscopy following ionization by a spark source. The samples contained less than 250 ppM oxygen; 50 ppM nitrogen; and 20 ppM hydrogen. For the first time it was possible to obtain curium metal from the gas phase by lysis of intermetallic compounds with Pd, Ir, and Pt at 1600°C. The method appears promising for production of pure metals in thin layers, especially of the lanthanide and actinide series. (H.B.G.)

55937 ATOMIC ACHIEVEMENT. Gray, J. L. (Atomic Energy of Canada Ltd., Ottawa). Chem. Ind. (London); No. 15, 598-600(5 Aug 1972).

An account is given of the development of nuclear power in Canada, together with the production of radioisotopes. Some examples of the contributions of chemistry are included. (UK)

55938 BEHAVIOR OF THE COLLOIDAL SOLUTION ^{99m}Tc MADE ON THE BASIS OF TIN HYDROXIDE OBTAINED FROM A SET OF STERILE REAGENTS. Kovalchuk, N. D.; Tarasov, N. F.; Gracheva, M. A.; Ilyushchenko, O. N. Med. Radiol.; 17: No. 6, 56-63(Jun 1972). (In Russian).

Results are reported on a study of the biological behavior of a new colloidal technetium-99m solution, obtained from a set of sterile reagents and ^{99m}Tc-labeled sodium pertechnetate eluated from the generator. In the course of the preparation storage, a gradual enlargement of the colloidal particles was observed. This process depended on the final pH value of the solution. The preparation was found to meet all requirements for use in the scanning of the liver and bone marrow. (auth)

55939 ADSORPTION OF ^{18}F ON GLASS, POLYETHYLENE, TITANIUM, AND ALUMINUM SURFACES. Mudrova, B.; Svoboda, K. (Nuclear Research Inst., Rez, Czech.). Radiochem. Radioanal. Lett.; 11: No. 3-4, 177-85(15 Sep 1972).

The adsorption of fluorine on glass, polyethylene, titanium, and aluminum surfaces was studied in connection with the experimental production of ^{18}F. The time dependence curves of adsorption on glass and titanium are characterized by a maximum. The results of adsorption and desorption experiments indicate that the mechanism of fluorine adsorption on surfaces studied is rather complex. (auth)

55940 OPTIMIZATION OF ELUTION CONDITIONS OF ^{113m}In GENERATORS WITH PARTICULAR REFERENCE TO THE ^{113}Sn BREAK-THROUGH. Hawliczek, F.; Ogris, E. (Stadt Wien–Lainz, Vienna). Nucl.-Med.; 11: No. 2, 194-200(15 Aug 1972). (In German).

Elution parameters of ^{113}Sn – ^{113m}In generators absorbed on ZnO_2 and SiO_2 were studied. The two types of generators do not behave identically. The optimum elution conditions are demonstrated. The two types of generators also do not behave identically concerning the ^{113}Sn breakthrough although it was found to be below 10^{-4}, which does not represent essential radiation hazard to the patients. No influence of aging on the elution activity of ^{113}In and of the ^{113}Sn breakthrough was found. (auth)

55941 STUDY OF ^{68}Ga–EDTA COMPLEX POSSIBLE APPLICATIONS IN NUCLEAR MEDICINE. Colombetti, L. G. (Stanford Univ., Calif.); Togami, E.; Ravasini, R. Acta Isotop.; 11: No. 1, 17-25(15 Jan 1971).

A simple way to free ^{68}Ga from its chelate with EDTA is presented. About 80% of the available gallium can be labeled when this reaction is used. It is easy to carry out and the time to run the reaction is only 2 to 3 minutes. Sterility can be maintained, so that autoclaving is unnecessary. (auth)

55942 PRODUCTION OF SHORT-LIVED ISOTOPES BY VAN DE GRAAFF ACCELERATORS. Cohen, B. L.; Canada, T. R. (Univ. of Pittsburgh). Phys. Med. Biol.; 17: No. 3, 416-17(May 1972).

It is suggested in a very brief note that Van der Graaff accelerators are as suitable as cyclotrons for the production of the following isotopes of medical interest: ^{11}C (20 min), ^{13}N (10 min), ^{15}O (2 min) and ^{18}F (112 min). It is pointed out that there is negligible disturbance of other programmes and an example is mentioned of ^{18}Fe production at the University of Pittsburgh Van der Graaff accelerator by the Ne(d, α) reaction with 30 min bombardment time. (UK)

Reactor Fuel Reprocessing

Refer also to abstracts 56644 and 58408.

55943 (ANL–7931) CHEMICAL ENGINEERING DIVISION, FUEL CYCLE TECHNOLOGY QUARTERLY REPORT, JANUARY–MARCH 1972. Webster, D. S.; Jonke, A. A.; Bernstein, G. J.; Levitz, N. M.; Miller, W. E.; Steindler, M. J.; Vogel, R. C. (Argonne National Lab., Ill.). Aug 1972. Contract W-31-109-Eng-38. 89p. Dep. NTIS.

During the period January through March 1972, work was done in the following areas: (1) conceptual design of a distillation unit for the recovery of U–Pu from Zn–Mg solutions, experimental work on the separation of U–Pu by its precipitation from Zn–Mg solutions, and laboratory work on a process to separate CaO from the reduction salt of the pyrochemical head-end process to reduce waste volume and allow recycle of the reduction salt; (2) engineering-scale work on the denitration of uranyl nitrate-plutonium nitrate solutions to $UO_3 - PuO_2$ in a fluid bed, the evaluation of a jet grinder, and the dissolution of $UO_3 - PuO_2$ denitration product for recycle to the denitrator; (3) investigation of the effects of original particle size and dished ends of pellets on x-ray fluorescence signals in an analytical procedure for determining Pu/U ratios in LMFBR oxide fuel; (4) study of the effect of mixing chamber configuration and entrained solids on the stability of hydraulic operation and the pumping capacity of a centrifugal contactor (for plutonium extraction steps in solvent extraction); (5) operation of an electrolytic cell (for the reduction of plutonium for a Purex process application) to determine the effects of flow velocity on current density and to determine current efficiency from changes in electrolyte composition, i.e., Pu(IV) concentration; and (6) an estimation of the production rates and behavior of tritium and noble gases in power reactors so that procedures may be evaluated for disposing of these wastes. (auth)

55944 (BARC–618) INFLUENCE OF URANIUM ON THE DISTRIBUTION COEFFICIENTS OF PLUTONIUM (IV) IN TRILAURYLAMINE. Kumar, S. V.; Kapoor, S. C.; Jain, S. P. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 17p. Dep. NTIS (U. S. Sales Only).

Experiments were carried out with trilaurylamine to study the possibility of using this solvent for the final purification of plutonium in the reprocessing of irradiated fuels by the Purex process. The distribution coefficients for plutonium in trilaurylamine depend upon the concentration of uranium and the type of diluent used. The distribution coefficients for plutonium were determined in presence of uranium (concentration varying from 0.5 to 20 g/l) with 20% trilaurylamine using two diluents, namely Shell sol T(aliphatic) and Solvesso 100 (aromatic). It was observed that the distribution coefficients were sufficiently high to achieve quantitative extraction and also obtain a good decontamination with respect to uranium. (auth)

55945 (HEDL-TME–72-67) DISSOLUTION OF UNIRRADIATED MECHANICALLY BLENDED, SOL GEL, AND COPRECIPITATED MIXED OXIDE FUEL. Lerch, R. E. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1972. Contract AT(45-1)-2170. 127p. Dep. NTIS.

Statistical experiments were performed to determine the effects of various fuel fabrication conditions on the dissolution properties of nonirradiated mixed oxide fuel fabricated by three candidate LMFBR fuel fabrication processes: mechanical blending, sol gel, and coprecipitation. Where fabrication conditions were directly comparable, coprecipitated fuel dissolved more completely than sol gel fuel which, in turn, dissolved more completely than mechanically blended fuel. The effect of voloxidation on dissolution of mechanically blended fuel was also investigated. The relationship between pellet homogeneity and fuel dissolution properties was investigated. (auth)

55946 (KFK–1529) EVALUATION OF A PHOTOMETRIC SEVERAL COMPONENT ANALYSIS WITH CALAS. Rietzschel, K.; Zinecker, H.; Kuhn, E. (Kernforschungszentrum, Karlsruhe (West Germany)). May 1972. 16p. (In German). Dep. NTIS (U. S. Sales Only).

A process is described for the evaluation of a photometric 4-component analysis to determine nitric acid concentration from conductivity for process control in fuel reprocessing using the Purex Process. (auth)

55947 METHOD OF SEPARATING Pu FROM AN ORGANIC PHASE. Chardin, Madeleine; Germain, Michel (to Commissariat a l'Energie Atomique). French Patent 2,092,832. 28 Jan 1972. Filed 23 Jun 1970. (In French).

In installations for the processing of irradiated fuels, the last stages in the purification of Pu consist of extracting it by an organic phase (tridodecylamine diluted in an inert solvent), re-extracting this organic phase, and precipitating it. The procedure presented consists of precipitating the Pu in the tridodecylamine directly from the last extraction cycle: a reagent (tridodecylamine fluoride or oxalic acid in a light alcohol solution) that precipitates the soluble Pu is added to the tridodecylamine, and the precipitate formed is separated. (France)

55948 METHOD FOR PURIFYING EFFLUENTS. Sugier, Pierre (to Commissariat a l'Energie Atomique). French Patent 2,087,565. 31 Dec 1971. Filed 22 May 1970. (In French).

A method is described for decontamination (removal of nitric or hydrochloric ions) of liquid effluents arising in U processing plants (plants for processing U ores, refining U concentrates, or reprocessing irradiated fuels). The solutions are treated with calcium hydroxide to give calcium nitrate or chloride and a quantity of H_2SO_4, sufficient to decompose this nitrate or chloride into insoluble calcium sulfate and HNO_3 or HCl, is added. The recoverable nitric or hydrochloric acid is at least partially recycled. The calcium sulfate is recovered using a filtration process. (France)

55949 EQUIPMENT FOR ISOLATING A MATERIAL BY SUBLIMATION. Alles, Maurice; Niver, Andre; Isidore, Jacques; (and others) (to Commissariat a l'Energie Atomique). French Patent 2,086,793. 31 Dec 1971. Filed 9 Apr 1970. (In French).

Equipment for isolating a material by sublimation is described, applications being the extraction of a coating material, the purification of a material containing impurities, or possibly the simultaneous effecting of both operations. The equipment can be used to declad irradiated fuel slugs by sublimating the Mg cladding. The heated Mg is vaporized in a vacuum furnace. This furnace contains a continuously cooled rotating drum on which the Mg vapor sublimates. A special tool is provided, which is controlled from the outside, and smooths the surface of this drum. The Mg, shaved off in this way, is collected in a receptacle. The drum is maintained at a sufficiently low temperature to act as a condenser; its rotation enables the presentation of a cold clean surface to the vaporized material. Continuous operation is thus possible. (France)

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Refer also to abstracts 56018, 56022, 56023, 56065–56067, 56073, 56077, 56285, 56309–56311, and 57875.

55950 (K–1837) PERFORMANCE EVALUATION OF A POWER RECOVERY WASTE HEAT BOILER. Szady, A. J. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 14 Sep 1972. Contract W-7405-eng-26. 29p. Dep. NTIS.

A computer program has been developed to numerically simulate the performance of an exhaust heat, power recovery boiler, operating in a refrigerant Rankine cycle. The boilers studied are either of the tube-and-fin or the plate-and-fin design. Each boiler or cooler is made up of a preheat section in series with the actual boiling section. Only one exhaust gas pass is considered; however, the coolant side can have any number of specified passes in the preheat section with one final boiling pass. Each individual pass may contain any number of tube rows. The modes of heat transfer considered are: forced convection—liquid and gas, conduction—fin-and-tube, and boiling and subcooled boiling. The cooler boiling temperature is determined for any specified waste heat load and cycle condensing temperature. Each tube row within the boiler and preheater is considered individually and broken into a number of specified increments. A heat balance is computed for each increment, allowing a complete temperature profile to be determined for the exhaust gas and refrigerant within the cooler. An example case is presented. (auth)

55951 (ORNL-TM–3586) REVIEW OF DEVELOPMENT STATUS OF SMALL TURBINE-GENERATOR UNITS SUITABLE FOR THE NAVY UNDERSEA POWER PLANT. Fraas, A. P. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 31p. Dep. NTIS.

The development status of small turbine and engine generator units that might be used with isotope power sources for undersea applications requiring from 2 to 10 kW(e) is reviewed. The review includes units designed and built by NASA-AiResearch, Aerojet, G.E., Solar, Stratos, Sundstrand, Swenson, Thermoelectron, and Westinghouse. Where available and pertinent, drawings, performance data, and operational problems are included. (auth)

55952 (SAN–651-130) 6 KW SYSTEM EVALUATION AND ENDURANCE. A.E.C. Organic Rankine Cycle Technology Program Topical Report. Niggemann, R. E. (Sundstrand Aviation-Rockford, Ill.). 8 Sep 1972. Contract AT(04-3)-651. 90p. Dep. NTIS.

The program and results for performance and endurance testing of a 6-kW(e) organic Rankine cycle power conversion system are presented. The system was developed for converting heat energy from vaporized Dowtherm A to electric energy and for pumping fluids to add and remove heat from the system. This machinery comprises a turbine, electric alternator, and vaporizer feed pump on an integral shaft. Performance data with Dowtherm A working fluid were obtained for the following test conditions: 650°F turbine inlet temperature and 0.5 psia turbine back pressure using both surface condenser and jet condenser; 700°F turbine inlet temperature and 0.5 psia turbine back pressure using jet condenser; and endurance testing for 3000 h at 700°F turbine inlet temperature using jet condenser. Performance measurements indicate that with reworked regenerators, and in the case of the jet condenser configuration, with a pump designed for the specific operating conditions, both systems would produce a system efficiency of over 17%. All rotating equipment was in excellent condition upon completion of the 3000 h endurance test. (L.C.L.)

55953 APPARATUS FOR THE CONVERSION OF HIGH-TEMPERATURE PLASMA ENERGY INTO ELECTRICAL ENERGY. Moir, Ralph W. (to United States Atomic Energy Commission). U. S. Patent 3,668,065. 6 Jun 1972. Filed 15 Sep 1970.

High-temperature plasma is produced in a controlled thermonuclear reactor and a plasma beam is directed therefrom through an expander having a decreasing intensity magnetic field to provide an ion beam in which the ions have substantially only translational kinetic energy. The ions of the beam are then directed, by application of an E × B field, into an off-set collector system having collectors arranged in a zig-zag pattern while the electrons are separated from the ions. The collectors situated in an E × B field have progressively lower retarding potentials applied thereto so that ions having a kinetic energy exceeding that of a particular stage are collected in successively lower energy groups to produce an electrical current therein. An advantage is obtained in that ions in a beam having a wide energy spread are collected at an electrode where there is a low energy differential between the effective retarding potential of the particular collector electrode and the group of energetic ions collected making for efficient conversion of the kinetic energy of the particles into electrical energy. (Official Gazette)

55954 TRANSPORTATION. I. WANTED: SUPERBATTERIES. Beardsley, Charles IEEE (Inst. Elec. Electron. Eng.), Spectrum; 9: No. 7, 42(Jul 1972).

The need for the development of superbatteries for use in electric cars is examined. It is noted that present electric cars do not accelerate nearly as fast as cars powered with internal combustion engines rendering them less than competitive in turnpike traffic. Battery research efforts are briefly reviewed. (J.R.D.)

55955 TRANSPORTATION. II. TWO FOR THE ROAD. Salihi, Jalal T. (Advanced Automotive Power Systems, Ann Arbor, Mich.). IEEE (Inst. Elec. Electron. Eng.), Spectrum; 9: No. 7, 43-7(Jul 1972).

It is noted that the most important component of electric cars calling for intensive research and development is a high-energy, high-power-density battery. Development efforts devoted to lead-acid batteries for limited range electric vehicles and advanced batteries such as Ni–Zn, Zn–Cl, and metal–air for long-driving-range vehicles are reviewed. Research on Li–S and Na–S batteries is also reviewed along with research on other candidate materials. (J.R.D.)

55956 SOLAR ERA. PART 1. THE PRACTICAL PROMISE. Gaucher, Leon P. Mech. Eng.; 94: No. 8, 9-12(Aug 1972).

Development effort devoted to finding ways of collecting and converting solar energy is reviewed. Discussions are included on need for solar energy, solar plants and complexes of the future, R & D requirements, and research prospects. It is noted that so far, government research funds have been restricted to projects supporting solar cells, thermionics, and thermoelectric devices. (J.R.D.)

55957 TRENDS IN ENERGY NEEDS. Ritchings, Frank A. (Ebasco Services Inc., New York). Mech. Eng.: 94: No. 8, 18-23(Aug 1972).

Requirements for energy in the U. S. are reviewed. Data and predictions are presented which support conclusions that total energy consumption is related to population growth, and in the U. S. is increasing at a rate of about three times that of population and that consumption of energy, in all forms, is a vital ingredient in economic growth, in the continuing improvement in standards of living, and in increasing income per capita in the U. S. It is also concluded that consumption of energy presents environmental problems, but means will be found to control the environmental impact without having to reduce our appetite for energy. The energy sources that will be used and the form in which energy is used are related to technological developments, the availability of fuel resources, and consumer preferences. It is expected that all of these factors will result in electric power becoming an ever larger source of energy to the ultimate consumer in the decades ahead. (J.R.D.)

55958 GEYSERS GEOTHERMAL POWER PLANT. Finney, J. P. (Pacific Gas and Electric Co., San Francisco). Chem. Eng. Progr.; 68: No. 7, 83-6(Jul 1972).

Development and operation of a geothermal power plant at the Geysers located in Sonoma County California by the Pacific Gas and Electric Co. is reported. The generation of electric power has proven commercially successful at the Geysers. Power production costs there compare favorably with those of PG&E's latest supercritical fossil units. Attention to design, operation, and maintenance have overcome problems associated with particulate matter in the steam and the corrosiveness of the condensate. Additional generating capacity is scheduled each year through 1974, at which time it will total 502,000 kW, making the Geysers power plant the largest geothermal power installation in the world. Beyond that, additional capacity will continue to be installed as additional steam reserves are developed. (J.R.D.)

55959 HUMAN COSTS OF NUCLEAR POWER. Sagan, L. A. (Palo Alto Medical Clinic, Calif.). Science; 177: No. 4048, 487-93(11 Aug 1972).

The human costs of producing and utilizing nuclear fuel to generate electricity and their relations with the price of electricity are examined. Data and information are presented which provide useful insights into the magnitude and distribution of the human costs of generating electricity from nuclear fuels. Society is able to maintain low prices by evading environmental costs and, as shown, by failing to pay the costs of occupational injuries. At the same time, the price of nuclear energy is maintained at an artificially high level by an overprotective governmental policy that restricts the public's exposures to radiation to a far greater extent than can be justified in terms of risk reduction or the costs of reducing other (that is, medical) exposures to radiation. (J.R.D.)

55960 NON-LINEAR INTERNAL RESISTANCE OF AN EGD GENERATOR. Malaczynski, Gerard W. (Massachusetts Inst. of Tech., Cambridge). Pr. Inst. Masz. Przeply.; No. 58: 3-9 (1972).

An electrogasdynamic generator model is presented in which account is taken of the influence of outlet section on the process in the region of conversion. By formulating appropriate boundary conditions for the selected generator model, it was possible to determine nonlinear internal resistance of the generator as function of flow parameters and the model geometry. (auth)

55961 SURVEY OF FRANCE. Giraud, A. (CEA, Paris); Vendryes, G.; Coates, J. H.; (and others). Nucl. Eng. Int.; 17: No. 196, 685-716(Sep 1972).

The survey comprises fifteen articles on the French nuclear industry. The future for nuclear power in France is discussed. Activities of the CEA in research and development and in the fuel cycle field are described: details are given of progress on the gaseous diffusion plant project, and of fuel and fuel element fabrication including the plutonium fuel fabrication facility at Cadarache. The recent reorganization of the French nuclear industry which involved boiler making and heavy engineering, chemicals and special metals, and electrical and mechanical equipment, is outlined. Several articles cover the work of the private sectors of industry in fuel and fuel element manufacture, fuel reprocessing, production of nuclear materials, development and production of measuring equipment and reactor components, civil engineering including experience in building PWR's, and development work on fast and high-temperature reactors. A pullout chart shows the principal government and industrial organizations, their activities and inter-connections. (UK)

55962 END-LOOP SHORTING IN NONEQUILIBRIUM MHD GENERATORS. Decher, R. (Univ. of Washington, Seattle). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 10: No. 8, 983-4 (Aug 1972).

The characteristics of the plasma are examined in the exit region of a nonequilibrium MHD generator which is shorted axially by highly conducting gas layers along the electrode walls. The axial extent of the exit region is governed by conditions at the generator exit which are in turn affected by the exit region's ability to prevent shorting currents from flowing. For operating conditions of interest, this length is determined. The important parameters which govern it and the aerodynamic techniques which minimize it are delineated. Thus, if the ends of the generator play an important role in determining the characteristics of the shorting wall layers, the means identified here may be used to minimize the conductance of the exit region. (auth)

55963 ELECTROPHILIC PROPERTY OF URANIUM HEXAFLUORIDE. Wu, J. C.; Williams, J. R.; Handley, J. C.; Cooper, B. P. (Georgia Inst. of Tech., Atlanta). J. Spacecraft Rockets; 9: No. 8, 614-16(Aug 1972).

Results of investigations on the use of UF_6 as the fuel for gas core reactor—MHD power plants are presented. It is noted that injection of small quantities of SF_6 into flowing plasma under spacecraft reentry conditions depletes the free electron population in the plasma by electron attachment to the SF_6 molecules forming negative ions. It is also noted that under conditions of interest in MHD generator operation, the working fluid is a plasma whose electric conductivity is attributable to the presence of free electrons. Whether UF_6 is electrophilic as is SF_6, must be established in order to determine its value as a plasma for MHD generators. Experimental data show that UF_6 is electrophilic and that its use in a gas core—MHD generator is probably impractical. (J.R.D.)

55964 TESTING OF TWO ASSEMBLIES OF THERMAL-EMISSION CONVERTERS IN A WATER-MODERATED WATER-COOLED REACTOR. Batalov, A. A.; Zaitsev, V. M.; Zvonov, N. V.; (and others). At. Energ. (USSR); 33: No. 3, 753-6(Sep 1972). (In Russian).

A thermionic full-length converter with a molybdenum emitter is described and the results of in-pile tests of two such converters are presented. The converters functioned in the water-moderated water-cooled reactor for 900 and 1400 hours, respectively. In the first case, the maximum specific electric power was $\sim$1.5 W/cm^2 and the emitter temperature 1550°C; in the second case, $\sim$2 W/cm^2 and 1650°C, respectively. (auth)

55965 IS NUCLEAR FISSION ACCEPTABLE? Gofman, J. W. (Univ. of California, Livermore). Futures; 4: No. 3, 211-19 (Sep 1972).

Fossil fuels, including coal, oil and gas, cannot be counted upon as a major energy fuel resource over a long time period. Given that energy utilization patterns will not alter from those presently characteristic then only three potential fuel sources currently appear adequate to meet the large part of future requirements. These are solar, nuclear fusion, and nuclear fission energy. Of these, nuclear fusion energy remains technically unproved. In the highly developed world, nuclear fission appears to have been chosen as the major future energy resource. But many would hold that promotional opportunism of the nuclear establishment rather than merit has served as the basis for this choice. Specific topics discussed are: the biological problems associated with nuclear fission, the fission product problem, the plutonium problem, the major accident problem, other possible choices of energy fuels. (auth)

55966 STRATEGIC ENERGY SUPPLY AND NATIONAL SECURITY. Vansant, Carl. Praeger Special Studies in International Politics and Public Affairs. New York; Praeger Publishers, Inc. (1971). 147p. $15.00.

The world's energy supply is inherently a strategic issue because of the inequitable distribution of resources—oil, coal, nuclear, hydraulic—and increasing technological demands for power. This book deals with this strategic aspect, provides a comprehensive overview of energy supplies around the world, and assesses the strength of the various nations from this perspective. The international aspects of energy discovery, development and use are discussed. Potential problems and new directions for technological exploitation are enumerated. (auth)

55967 ENERGY AND ENVIRONMENT. Seaborg, G. T. (Univ. of California, Berkeley). Int. J. Environ. Stud.; 3: No. 4, 301-6(Sep 1972).

The world today is faced with the increasingly difficult dilemma of generating sufficient energy, especially electric energy, to satisfy its rapidly growing needs while at the same time restoring and preserving its natural environment. Among the various alternatives the fossil fuel (mainly coal) and nuclear (fission) sources are the only major possibilities for meeting the requirements during the next few decades. The nuclear source has the advantages of minimal air pollution and almost unlimited fuel resource availability when the breeder reactor becomes available. The characteristic environmental impact of the nuclear source can be made acceptable under a proper program of management. (auth)

55968 LARGE-SCALE CONCENTRATION AND CONVERSION OF SOLAR ENERGY. Hildebrandt, A. F.; Haas, G. M.; Jenkins, W. R.; Colaco, J. P. (Univ. of Houston, Tex.). EOS, Trans, Amer. Geophys. Union; 53: No. 7, 684-92(Jul 1972).

A system for concentrating and conversion of solar energy by means of movable mirrors that reflect the energy onto a single collector atop a large tower is described. The concentrated energy is converted to electrical power either by means of a steam cycle, using liquid metals for heat transfer down the tower, or by a closed cycle magnetohydrodynamic generator. The intermittent nature of the solar energy is overcome by electrolyzing water into hydrogen and oxygen. Energy storage in the form of hydrogen is especially attractive since it offers the possibility of a pollution-free fuel for internal combustion engines. (T.D.)

55969 HOW WILL WE MEET THE ENERGY CRISIS? POWER FOR TOMORROW'S WORLD. Millard, Reed. Tomorrow's World Series. New York; Simon and Schuster, Inc. (1971). 190p. $4.29.

Programs directed to meeting the energy crisis are examined. Discussions and information are presented in chapters on the energy crisis, fuels for power without pollution, power from the atom, safety of atomic power plants, new ways to deliver power, miniature power plants, power from rivers, power from the sea, power from the earth, and power from the sun. (J.R.D.)

55970 METHOD AND MEANS OF CONVERTING ATOMIC ENERGY INTO UTILIZABLE KINETIC ENERGY. Papp, Josef (to Environetics, Inc.). U. S. Patent 3,670,494. 20 Jun 1972. Filed 31 Oct 1968.

Methods are described of utilizing potential energy of atoms and various forms of radiation (electrons, photons, positrons, and beta and alpha particles) in a controlled power generating system. Effective mixtures of chemical elements adapted for use in the method are described along with the preparation of charges of ingredients for use in virtually gas-tight power generating devices and the activation and control of such charges and devices. Structural requirements of power generating devices utilizing the methods and compositions are also described. (Official Gazette)

55971 BASIS OF THE LONG-RANGE FORECASTING OF ELECTRICAL POWER CONSUMPTION IN ROMANIA. Manea, Sora; Liciu, N.; Panaitescu, G. Stud. Cercet. Energ. Electroteh.; 22: No. 2, 241-52(1972). (In Rumanian).

In view of the great convenience of the generation, transmission, distribution, and utilization of electrical energy, its percentage in the overall power balance of Romania increased from 15% in 1955 to 19% in 1970; at the same time the specific fuel consumption decreased. It is of great economic interest to forecast the consumption rate for a long period. A polynomial function, based on the extrapolation of earlier trends, was developed to forecast the evolution of the electrical power consumption during the 1971 to 2000 period, giving stronger weight to statistical data relating to recent years. The forecast can be further improved by a correlation method which takes economic indicators into account. It is expected that the electrical consumption in Romania and the correlated industrial production will continue to be represented by a concave curve during the 1975 to 78 period, after which it is expected to become more or less linear. The various computing techniques yielded somewhat different values for the slope of the growth line. It is believed that more errors result from an underestimation than from an overestimation of the anticipated power consumption values. (TTT)

55972 EXPERIMENTAL INVESTIGATION OF ELECTRON EMISSION OF A TUNGSTEN CATHODE IN A CESIUM PLASMA. Blom, J. H.; Pels, H. J. (Eindhoven Univ. of Tech., Netherlands). Appl. Phys. Lett.; 21: No. 6, 283-5(15 Sep 1972).

The voltage drop at a tungsten cathode surrounded by cesium plasma is measured as a function of the current density and temperature of the cathode. Current densities, an order of magnitude higher than predicted by the Langmuir S curves, accompanied with low voltage drops, have been measured for certain cathode temperature regimes. These results seem to be of interest for the emission properties of electrodes in closed-cycle MHD generators. (auth)

55973 1971 INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE, BOSTON, MASSACHUSETTS, AUGUST 3–5, 1971. New York; Society of Automotive Engineers, Inc. (1971). 1375p. $55.00. (CONF-710803).

Papers are presented covering various energy conversion techniques and equipment. The devices and systems discussed include solar cells, power cycles, radioisotope thermoelectric converters, fuel cells, piezoelectric converters, automotive power systems, underwater power systems, space power systems, fusion power, fission reactors, and fossil fuel power plants. A separate abstract was prepared for 69 papers. Two papers were previously abstracted for NSA and may be located under CONF-710803 in the Report Number Index. (H.D.R.)

For abstracts of individual papers see: 55974–56010, 56022, 56153, 56154, 56304–56315, 57843–57845, 58324–58336, and 58398.

55974 NEW VIEW OF SOLAR ENERGY. Glaser, Peter E. (Arthur D. Little, Inc., Cambridge, Mass.). pp 1-4 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The large-scale application of solar energy is proposed for consideration in a framework which recognizes that: energy is a prerequisite for many social and environmental goals; efficiency of energy resource utilization must be improved; and a comprehensive national energy policy has to evolve so that meaningful options can be developed for the future. The nature of solar energy and environmental effects are outlined. Practical ways of using solar energy are considered and research needs are reviewed. (auth)

55975 LARGE TERRESTRIAL SOLAR ARRAYS. Rink, Jack E.; Hewitt, Jack G. Jr. (Univ. of Denver). pp 15-22 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston. MA. (3 Aug 1971). See CONF-710803.

Enormous amounts of solar energy reach the desert areas of the southwestern United States every day. A concept for converting this solar energy to electrical energy and storing sufficient energy for use during nighttime and overcast periods in pumped storage facilities is described. The system described would satisfy all of the electrical power needs for the state of Arizona in 1990. Facilities are also described for satisfying 40% of the electrical energy requirements of the eleven western states in 1990. Cost estimates of these solar energy conversion and storage facilities are determined. (auth)

55976 HYDROGEN: A CLEAN FUEL FOR URBAN AREAS. Winsche, W. E.; Sheehan, T. V.; Hoffman, K. C. (Brookhaven National Lab., Upton, N. Y.). pp 23-8 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The use of hydrogen as a clean general-purpose fuel for the more densely populated sections of an urban area is studied as a means of reducing air pollution and to provide for the effective utilization of off-peak electric power. A forecast of the 1985 electric power supply for the entire metropolitan New York City region, including suburban counties, indicates that sufficient hydrogen could be produced by the electrolysis of water, using the off-peak electrical power available throughout the region, to provide over half of the energy required for transportation or, alternatively, nearly all of the space heat requirements within the New York City limits where the environmental problems are most severe. Additional hydrogen could be produced from coal and delivered to the City by pipeline to provide the balance of the energy needs for transportation as well as for household, commercial, and industrial use. A combined hydrogen and electrical energy supply would eliminate all of the CO_2, CO, hydrocarbon, SO_2, and particulate emissions from energy conversion devices located within the City. The by-product oxygen produced along with the hydrogen in the electrolysis operation provides an ample supply throughout the metropolitan region for the treatment of sewage and industrial wastes, for use as the oxidizer to eliminate NO_x emission from incinerators and for the treatment and revitalization of polluted bodies of water. (auth)

55977 STATUS OF THE 2- TO 15-kW$_e$ BRAYTON POWER SYSTEM AND POTENTIAL GAINS FROM COMPONENT IMPROVEMENTS. Klann, John L.; Wintucky, William T. (Lewis Research Center, Cleveland). pp 195-201 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

System and component tests of the 2- to 15 kW(e) Brayton power system are continuing. Key components have passed 5000 h of accumulated operating time. No basic technology problems were found. Based on the first system tests in a vacuum chamber, a net efficiency of 0.26 would be obtainable in space at 10 kW of useful electric power output; the specific radiator area would be about 75 ft^2/kW(e). Minor system hardware changes are described which would improve system net efficiency to about 0.30 in the 10- to 15-kW(e) range. Corresponding specific radiator areas would be 65 to 62 ft^2/kW(e). An advanced Brayton power system operating at a turbine-inlet temperature of 2000°F was considered. If developed, it could offer a system net efficiency up to about 0.35 at its high-power conditions; specific radiator area would drop to about 50 ft^2/kW(e). (auth)

55978 AUTOMATED ENDURANCE TESTING OF A BRAYTON POWER CONVERSION SYSTEM. Edkin, R. A.; Macosko, R. P.; Kruchowy, R. (Lewis Research Center, Cleveland). pp 202-10 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

To demonstrate endurance of a 2- to 15 kW(e) Brayton power system, a test system was designed and constructed at the NASA, Lewis Research Center. The system included the following Brayton prototype components: Brayton rotating unit, Brayton heat exchanger unit, interconnecting piping and gimbals, system check valve, coolant pump, electronic voltage regulator and series field controller, parasitic speed control and load resistor. Additional pieces of test support equipment were provided to simulate remaining system hardware not available at the time of construction. The test system was designed with two goals in mind. The first was to measure system and component performance. The second was to use a computer for monitoring and controlling a long-term steady-state endurance test. The system has been operated for more than 5300 h under computer control; in excess of 4600 h of testing were unattended by test personnel. During this time there have been no Brayton component failures and test support equipment problems have been minor in nature. The data acquisition and control system provided the following automatic functions: data recording and reduction; control room alarms on selected data channels (high and low limits); system control and adjustment; data storage for analysis of failures; and alarms to central fire station to select channels and computer failure. An extensive automatic protective system was also designed for the test and functioned separately from and as a backup to the computerized control system. The experience acquired in designing and working with such an automated test is discussed. (auth)

55979 PERFORMANCE OF A BRAYTON-CYCLE POWER CONVERSION SYSTEM USING A HELIUM–XENON GAS MIXTURE. Valerino, Alfred S.; Ream, Lloyd W. (Lewis Research Center, Cleveland). pp 211-19 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A Brayton power conversion system was operated in an ambient environment with a gas mixture of helium and xenon. The system was operated at a compressor inlet temperature of 80°F through a compressor discharge pressure range from 20 to 45 psia and through a turbine inlet temperature range from 1300° to 1600°F. Results of system and component performances through the operating range of parameters are discussed. Results of the investigation indicated a net engine efficiency (excluding heat losses from the heat source) of approximately 30% at a compressor discharge pressure of 45 psia and a turbine inlet temperature of 1600°F. The gross power output measured at the alternator terminals for this condition was 13.2 kW(e). Good agreement was obtained in a comparison of the compressor adiabatic efficiency with that obtained with the compressor tested with argon gas; compressor efficiencies of the order of 79% were obtained. With the blend of helium and xenon and with high turbine inlet temperatures (1300° to 1600°F) turbine static efficiency was slightly lower than with cold argon; the values were 87.5% and 88.8% with hot helium-xenon and cold argon, respectively. The heat-transfer effectiveness of 0.95 of the gas-to-gas recuperator agreed with the predicted value at a system pressure level of 45 psia. The head rise of the liquid coolant pump, approximately 193 ft at a design capacity of 3.7 gpm, was considerably higher than the specified minimum value of approximately 159 ft. (auth)

55980 POST TEST INSPECTION OF THREE BRAYTON ROTATING UNITS. Dunn, James H. (Lewis Research Center, Cleveland). pp 220-8 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The NASA Lewis Research Center has assembled and is testing a closed-Brayton-cycle space electric power conversion system. This system was designed to produce 2 to 10 kW net continuous electric power for at least 5 y. The turbine-alternator-compressor power conversion unit in this system is designated Brayton Rotating Unit (BRU). Four BRUs have been tested and have an accumulated running time in excess of 9000 h. These tests have demonstrated that the unit has met or exceeded performance objectives. Yet to be verified are the design objectives for life. Two BRUs have been disassembled and inspected after substantial running time. One BRU has operated for 700 h, another for 3000 h. The bearings ran successfully with no detectable change in bearing operation or performance. However, minor pitting was found in the ball-socket bearing pivots. Dimensional, electrical, and visual inspections revealed no other changes in the units. In testing two of the BRUs, inadvertent runaway occurred which resulted in bearing seizure at 52,000 rpm (140% of design speed) but with no damage external to the BRUs. In fact, damage was limited to the bearing assemblies. With just bearing replacement, both units have passed acceptance test. The failure mode of the bearings and the resulting damage are described. (auth)

55981 EXPERIMENTAL EVALUATION OF THE ELECTRICAL SUBSYSTEM OF THE 2- TO 15 kW BRAYTON POWER CONVERSION SYSTEM. Secunde, R. R.; Vrancik, J. E.; Spagnuolo, A. C. (Lewis Research Center, Cleveland). pp 229-38 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The electrical subsystem of the 1200 hertz, 2-to-15 kilowatt Brayton Power Conversion System consists of the auxiliary electrical equipment required for an integrated, self-contained power conversion system. All of the electrical components with the exception of valve operators, heaters, and the turbine-compressor-alternator unit are included. These components are the speed controller, alternator voltage regulator, dc power supply, batteries, two inverters, two coolant loops including the 400 Hz motor-driven pumps, and the Brayton Engine Control System. The electrical subsystem, powered by a motor-driven alternator, was evaluated under various system operating conditions in a vacuum environment in order to determine overall performance. A 10,000-h endurance test in vacuum is underway to verify the ability of the subsystem to function properly during long-term operation in space. Overall operation of the electrical subsystem was satisfactory. Deviations of system waveforms from a true sine wave have a small but measurable effect on the performance of individual components. Operation of the speed controller has a distorting effect on the 1200 hertz system voltage. The life of the originally selected silver-cadmium batteries was inadequate for long-term use in the Brayton power conversion system. (auth)

55982 MOTOR STARTING TECHNIQUES FOR THE 2- TO 15-kW BRAYTON SPACE POWER SYSTEM. Gilbert, L. J.; Curreri, J. S.; Cantoni, D. A. (Lewis Research Center, Cleveland). pp 239-44 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The 2-to-15 kilowatt Brayton space power system currently undergoing development and testing at Lewis Research Center has been effectively started by motoring the rotating unit. The rotating unit is comprised of a radial-flow turbine which drives a radial-flow compressor and a Lundell-type alternator. This Brayton power system generates 120/208 volts, 1200 Hz electrical power at a rated speed of 36,000 rpm. The system is designed for a turbine inlet temperature of 1600°F and can be operated with a variety of heat sources such as a nuclear reactor or radioisotope. By applying 20 volts line-to-neutral, 400 Hz electrical power to the alternator terminals at standstill, the rotating unit can be motored to a speed of 12,000 rpm in about 20 seconds. Upon removal of the input electrical power, the system self-accelerates to its rated speed, provided that the turbine inlet temperature is 875°F or higher. (auth)

55983 REVIEW OF THERMOELECTRIC CONVERSION IN MICRO/MILLIWATT POWER RANGE FOR BIO-MEDICAL APPLICATIONS. Raag, Valvo. pp 245-55 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The design considerations of micro/milliwatt radioisotope thermoelectric generators (RTG's) in biomedical applications are discussed and the role of different RTG technologies in the field of small-power thermoelectric energy conversion are considered. Conclusions are drawn regarding the advantages and disadvantages of the most common RTG technologies in this field. The discussion is illustrated by detailed design analyses of a 64.8 milliwatt RTG in terms of silicon-germanium, lead telluride, bismuth telluride and Cupron—Tophel wires. (auth)

55984 REVIEW OF LONG LIFE PERFORMANCE OF LEAD TELLURIDE AND SILICON GERMANIUM RTG TECHNOLOGIES. Caputo, Richard S. (California Inst. of Tech., Pasadena). pp 478-82 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The nominal performance of current RTG programs is reviewed and performance predictions are made for long term operation based on the most recent module data. The RTG programs which are considered for service of up to 5 or 7 years are TRANSIT (ISOTEC), PIONEER (SNAP 19-TAGS) and INTEGRAL SNAP 27 which use a lead telluride thermoelectric material, while the multi-hundred watt (MHW) silicon germanium generator is considered for missions as long as 12 years. The MHW system using the Atomic Energy Commission's Large Isotope Heat Source for near term missions or the greater development time Helipak heat source for later missions, holds the greatest potential for future RTG application. (auth)

55985 STUDY OF THE UTILIZATION OF THE MULTI-HUNDRED WATT RADIOISOTOPE THERMOELECTRIC GENERATOR FOR JET PROPULSION LABORATORY OUTER PLANET MISSIONS. Leonard, W. D. (Resalab Scientific, Inc., Menlo Park, Calif.); Merrill, O. S. pp 483-91 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The Multi-Hundred Watt Radioisotope Thermoelectric Generator (MHW-RTG) has been under study by the Jet Propulsion Laboratory since the inception of the AEC's MHW-RTG development program in October 1969. It is the power source being considered for missions to the outer planets in the 1975 to 1980 time period. Two of the topics considered incident to the use of the MHW-RTG are discussed, i.e., its vacuum and xenon-filled performance under anticipated operational conditions and its response to thermal and electrical transients. (auth)

55986 MULTIHUNDRED WATT RADIOISOTOPE THERMOELECTRIC GENERATOR (MHW-RTG). Pitrolo, A. A.; Morrow, R. B.; Arker, A. J. Contract AT(29-2)-2831. pp 492-511 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A summary of the significant results obtained on studies of Multi-Hundred Watt Radioisotope Thermoelectric Generators (MHW-RTG) is presented covering the period October 1969 through March 1971. This program, a systems technology effort, is developing a "work horse" system with high efficiency and long life, applicable to a wide range of potential space missions requiring 100 to 1000 watts of electrical power. It is scheduled for flight applications beginning in the mid-1970s. Discussed in this paper are: the performance and safety requirements for the system design and development; a description and performance parameters of the SiGe converter; a description and performance characteristics of the high temperature heat source for both operational and safety considerations; an examination of the system's growth flexibility by cascading with a low temperature stage to achieve even higher conversion efficiencies; and, finally the current program development schedule. (auth)

55987 PERFORMANCE TESTING AND EVALUATION OF A HIGH TEMPERATURE SILICON GERMANIUM THERMOELECTRIC GENERATOR. Stapfer, G.; Truscello, V. (California Inst. of Tech., Pasadena). pp 512-19 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The use of a thermoelectric generator on spacecraft proposed to conduct outer planet missions requires an in-depth understanding of its long term characteristics. The performance of one such generator, using a silicon germanium alloy for the thermoelectric conversion material, is presently under investigation by JPL. The generator and its initial performance including the "burn in" degradation characteristics are described. A complete performance map of the generator at various power input levels is presented and the results are discussed and analyzed. Initial life test results are presented and compared to a theoretical long-term degradation model. (auth)

55988 OPERATIONAL PERFORMANCE OF SNAP-21 THERMOELECTRIC POWER SYSTEMS. Pannemann, R. L. (Minnesota Mining and Mfg. Co., St. Paul). pp 556-62 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Vital to many areas of undersea technology is the availability of reliable underwater power sources. The SNAP-21 thermoelectric power system was designed to fulfill the need for a small lightweight 10-watt power source capable of operating in the deep ocean for long periods. Operational experience gained with four systems placed in an ocean test bed indicate a device of high stability was achieved which is easily deployable and capable of five years of unattended operation. (auth)

55989 POWER SUPPLY REQUIREMENTS FOR NATIONAL DATA BUOYS. Blose, James F. (Naval Ship Research and Development Lab., Washington, D. C.); Cox, Sidney W.; Petrie, George L. pp 587-98 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The mission of the National Data Buoy System is to gather and report environmental information from the earth's ocean areas. Power supplies for three types of buoys within the system are discussed in terms of past experience in other applications and current potential for these applications. Batteries, thermoelectric generators, and diesel-engine generators satisfy the spectrum of requirements. Areas of choice among these three are expected to be resolved by current investigations. (auth)

55990 DESIGN AND ANALYSIS OF A CASCADED THERMOELECTRIC GENERATOR. Rouklove, P. (California Inst. of Tech., Pasadena). pp 611-20 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

One of the means of improving the efficiency of a thermoelectric generator is the utilization of the waste heat rejected at the cold junction to drive another energy conversion stage. This improves the Carnot efficiency by increasing the temperature range of operation. Two schemes are available: One, the segmented couple approach, relies on an intimate contact between different thermoelectric materials, each operating in its most efficient range. The other approach consists of cascading two elements thermally but separated by mechanical means. The development and construction features of a cascaded generator using silicon-germanium (Si—Ge) thermoelectric elements as a first stage, coupled to a second stage of lead-telluride (Pb—Te) elements are presented. A heat pipe is utilized as the interstage thermal coupling mechanism. The device operates between 1283°K on the hot side of the Si—Ge stage and 464°K on the cold junction of the Pb—Te stage. As a preliminary step in the development of the cascaded generator, two Pb—Te modules of the same design as the cold stage of the cascaded generator were fabricated and tested, using a heat pipe to deliver the required thermal input. The results of these tests are presented. The design of the complete cascaded generator, including the interstage coupling, heater, and heat rejection system is described, as well as the details of the test equipment, and the results of the performance analysis. (auth)

55991 NONEQUILIBRIUM MHD GENERATORS IN NUCLEAR SPACE POWER SYSTEMS. Hoffman, Myron A.; Bertolini, Enzo (Univ. of California, Davis). pp 621-34 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The performance potential of MHD generators utilizing nonequilibrium ionization is reexamined in the light of recent information on ionization instabilities. Application to closed Brayton cycle, nuclear space power supplies is examined with emphasis on the 1 MW(e) to 10 MW(e) size range. A detailed analytical model of the nonequilibrium generator including friction, heat transfer, axial Hall voltage shorting, electrode voltage drops and ionization instabilities is used to determine a consistent generator efficiency, power output, and generator length for any specified pressure ratio. Integrated cycle analyses are then performed which yield not only the overall cycle efficiency and radiator area required, but also consistent component pressure drops, nuclear reactor dimensions, etc. Results of the cycle analyses indicate that space power supplies of a few megawatts electric power output can have specific radiator areas as low as 0.2 m^2/kW(e) for reactor outlet gas temperatures of 2000°K, even in the presence of ionization instabilities in the generator. This requires use of compressor intercooling and a compact, high-effectiveness regenerator, and yields overall cycle efficiencies around 30%. Initial results are also given for power supplies with power outputs from 0.20 MW(e) to 100 MW(e). In addition, some preliminary results are included for power supplies of a few megawatts electric power output, utilizing the NERVA nuclear reactor technology with reactor outlet temperatures up to 2500°K. These initial results indicate that use of a nonequilibrium MHD generator with reactor outlet temperatures between 2000°K and 2100°K produces as light a space power supply as one using an equilibrium conductivity MHD generator with reactor outlet temperature of about 2500°K. (auth)

55992 RADIOISOTOPE THERMOELECTRIC GENERATOR OPTIMIZATION TECHNIQUE. Leonard, W. D. (Resalab Scientific, Inc., Menlo Park, Calif.). pp 649-55 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A radioisotope thermoelectric generator has been proposed for the power source for scientific missions to Jupiter, Saturn, Uranus, Neptune, and Pluto. The reference design hot junction temperature of this generator assumed for this study is 1100°C. For early missions it may be necessary to operate the generator at reduced hot junction temperature to achieve stability and reliability needed for the Grand Tour missions which have lifetimes up to 12 years. A computer program was used for the optimization of generators operating at hot junction temperatures over a range of 700°C to 1100°C. Various geometric parameters of the generator were optimized to achieve maximum specific power within certain constraints. The parameters optimized were thermoelement length, thermoelement areas, number of couples, radiator area and heat input. The results of the optimization are compared with alternatives to a complete optimization such as a reduction in heat input and/or changes in thermoelement areas. (auth)

55993 RADIOISOTOPE THERMOELECTRIC GENERATOR SAFETY AND OPERATIONS CONSIDERATIONS FOR USERS OF LARGE NUCLEAR SPACE POWER SYSTEMS. Weber, William B. (California Inst. of Tech., Pasadena). pp 656-62 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A major program that is currently being studied as a part of the national space program involves unmanned missions to the outer planets. The distances at which these planets are located from the sun preclude the economical use of solar cells as the power source for such an application. Radioisotope Thermoelectric Generators (RTGs) will be used instead. Estimates of the amount of power that would be necessary to support a typical outer planets spacecraft indicate that the radioisotope fuel inventory will be large, on the order of 10,000 thermal watts, as compared to previous space nuclear systems of about 500 to 1500 thermal watts. The large fuel inventory can be expected to cause the user unusual problems in the area of safety and operations. The problems will be additionally complicated because they must be resolved with as little impact as possible upon normal spacecraft activities concerning development, integration and test. Although RTGs typically are designed to withstand severe environments of various kinds, they can themselves be the cause of inhospitable radiological environments to which personnel would be exposed. The prospective user must recognize the obligation to organize all RTG-oriented activities, from the program's developmental phase through to system launch, so as to minimize or preclude personnel hazard and exposure opportunities. Handling, testing, and integration activities must be planned to reflect this philosophy. The user who approaches the task in a perceptive fashion can take advantage of various alternatives and options that are available. At the request of the user it is possible that some features of the RTG design might be modified to reflect specific or unique safety and operations requirements of a particular application. For instance, designing the RTG for a field-fueling option in addition to (or instead of) a pre-fueled option has extensive operational ramifications. The user must rigorously review mission objectives and program philosophy to minimize the requirements for pre-launch usage of fueled RTGs since this is the simplest and surest technique to reduce occasions of exposure and hazard. This implies precise and sophisticated planning, scheduling, and coordinating of test and qualification activities to insure maximum effective use of unfueled models and/or RTGs. The user considerations that influence the safety and operations status of large radioisotope-fueled power sources are discussed. Developmental, integration, and test requirements consistent with typical activities and objectives are used to illustrate the alternatives which the user must review and act upon if personnel are to be exposed to minimal occasions of hazard without compromising the program. (auth)

55994 HIGH POWER DENSITY THERMOELECTRIC POWER SOURCES. **Nystrom, T. L. (Minnesota Mining and Mfg. Co., St. Paul); Angello, J. P. pp 731-40 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A family of lightweight, liquid fueled thermoelectric power sources are being developed for military field applications which cover the power range from 120 to 1100 W. The 500-W unit is in the engineering development phase and currently undergoing quality assurance testing. A description of the unit is given and the results of the tests are presented. (auth)

55995 CHEMICAL AND THERMAL LASER CONSIDERED AS AN ENERGY CONVERSION SYSTEM. **Hammitt, A. G. (TRW Inc., Redondo Beach, Calif.). pp 761-7 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The laser is a new energy conversion system capable of converting thermal or chemical energy to electromagnetic radiation. In the ideal limit, the process is reversible and subject to the usual thermodynamic limitations. The lasing process also imposes other limitations peculiar to this type of energy conversion system. (auth)

55996 DEMONSTRATION TEST OF 90-WATT ^{60}Co-FUELED THERMOELECTRIC GENERATOR. **Whatley, V. (E. I. du Pont de Nemours and Co., Aiken, S. C.); Ross, C. P.; McBeath, P. E.; (and others). pp 787-92 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A nominal 90 W(e) radioisotope thermoelectric generator was designed, fabricated, and fueled with 183,000 Ci of ^{60}Co. The unit is in operation at the Savannah River Laboratory. The generator employs a compact tubular thermoelectric converter designed by the Westinghouse Astronuclear Laboratory for Space Nuclear Systems of the AEC. High activity cobalt contained in the unit was produced at Savannah River. The generator was placed on test in February 1971 after being fueled in a hot cell at SRL. Endurance testing is being conducted in a normal working area to demonstrate the practical feasibility of ^{60}Co heat sources for power production. (auth)

55997 FREE PISTON BRAYTON ENGINE FOR LOW POWER. **Bjerklie, John W. (Mechanical Tech. Inc., Latham, N. Y.). pp 793-801 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A 3 kW Brayton cycle power system is proposed consisting of a gas lubricated free piston assembly made up of a double acting expander, a double acting compressor, and a reciprocating alternator. The key to the system is a two-spool valve system having a tuned valve for frequency control, and a second, two-piston valve, for cut-off control. Fuel consumption is estimated at 1.1 lb/kwh, size is $26\frac{1}{2}$ in. × $15\frac{1}{4}$ in. × 7 in. and weight is 75 lbs. The system, offering simplicity and good performance, is usable for standby or emergency power, or for portable, quiet power. (auth)

55998 THERMAL PERFORMANCE OF FLUIDS IN A RANKINE CYCLE POWER PLANT FOR AUTOMOTIVE APPLICATIONS. **Solberg, H. L.; Hawks, Keith H. (Purdue Univ., Lafayette, Ind.). pp 813-23 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Nine fluids were selected from a list of fifty-three for a study of their thermal performance in a Rankine Cycle power plant. Five of these nine fluids were selected for a further study of the effects of such factors as regenerative feed-liquid heating, changes in operating pressures and temperatures, feed-pump efficiency, engine efficiency, boiler efficiency, and condenser capacity. Of the fluids studied, steam, CP 34, and Freon 113 showed the best performances in that order. (auth)

55999 LOW-POLLUTION CLOSED BRAYTON CYCLE ENGINE. **Pietsch, A.; Rackley, R. A. (AiResearch Mfg. Co. of Arizona, Phoenix). pp 824-8 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The study results and design of a low pollution closed Brayton-cycle engine for automotive use are described. The engine consists of a single shaft recuperated gas turbine operating with air in a closed loop, including a combustion input heat exchanger and a heat rejection heat exchanger. Low exhaust emission pollution is achieved by a combustor that achieves complete combustion with only a slight excess of air. Formation of oxides of nitrogen is controlled by limiting the maximum combustion gas temperatures. A complete 150-hp closed Brayton engine has a volume of 10.3 ft^3 and weighs less than 550 lbs. The specific fuel consumption (SFC) at full power on a standard day is 0.55 lbs of fuel per hp-hr. Part load SFC is less than full load SFC down to 10% of full load power. Based on complete system tests the noise level of the closed Brayton engine is very low. The predominant noise will be from the fans and accessories. The closed Brayton-cycle engine promises to be an excellent solution to the chemical, noise, and thermal environmental pollution problems. (auth)

56000 VIKING LANDER POWER SYSTEM. **Smith, R. D. (Langley Research Center, Va.); Seals, D. R.; Farley, K. pp 829-36 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The functional aspects of the selected Viking Lander Power System are described as well as the state-of-art problems imposed by the Viking 1975 Mission and Science objectives and scopes the Component development necessary to achieve power system reliability. Two Viking spacecraft, each consisting of an orbiter and a soft-lander, will be launched in late summer of 1975 to arrive at the planet Mars in early summer of 1976. The spacecraft will be placed in Mars orbit and a mapping mission performed to determine preferred landing sites. Once the site is selected, the Viking Lander will separate from the orbiter, deorbit, enter through the atmosphere, and land on Mars. Upon landing, the Lander will perform a variety of scientific investigations including life detection, molecular analysis of the soil, imaging and meteorology. The total required life of the Lander is twenty-four months which includes three months of Mars surface operation. A total vehicle heat sterilization requirement imposes unusual restraints on the power system. Foremost of these is in the development of a long life and high cycle capability, heat sterilizable battery for energy storage and in the development of associated power conversion, regulation and distribution equipment. Radioisotope Thermoelectric Generators (RTGs) will be used as the prime energy source. Integration of the RTG, used both for electrical power and thermal control, into the Lander is discussed as a function of the various mission phases and the unique Mars surface environment. (auth)

56001 SOLAR ARRAY TECHNOLOGY FOR LUNAR SURFACE APPLICATIONS. Boretz, J. E. (TRW Inc., Redondo Beach, Calif.); Miller, J. L. pp 837-49 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Solar array technology has been evolving for over a decade. Major strides have been made in improving the performance, life, and reliability of the various components comprising a solar array system. One area of development has been that associated with the utilization of solar arrays on the lunar surface. Because of the unique aspects of the lunar environment (i.e., $^1/_6$ g and temperature extremes from +130°C to −173°C) various design criteria, normally found acceptable for earth orbital applications, must be modified when considered for lunar surface applications. The evolution of this technology as a result of various analyses and technology development activities is discussed. The initial emphasis was on the generation of parametric performance data for both silicon cells and cadmium sulfide thin films. Major factors affecting array performance were found to be configuration, array temperature, and radiation degradation. In follow-up analyses, it was further determined that substrate materials and design, as well as deployment techniques could have a major impact on array weight. As a result of these theoretical investigations, a baseline array configuration and candidate solar array modules were selected. A development test program was devised to experimentally evaluate the adequacy of three candidate engineering test models to meet the launch, lunar descent, and lunar surface operational environments. During the course of this environmental testing, several phenomena occurred which resulted in adhesive bond or cell interconnect failures. These had not been previously anticipated analytically. This paper discusses the nature of these failure modes and delineates the analytical and experimental techniques utilized in evaluating these phenomena. For example, the various critical geometric parameters and material properties are identified and the analytical approach taken to evaluate these failure modes are indicated. Of particular interest is identification of the critical parameters associated with silicon cell spalling. Finally, recommendations are made for a prototype solar array module which should be capable of meeting all of the environmental operational extremes associated with lunar surface solar array applications. Test data confirming the technology readiness of this prototype design is also provided. (auth)

56002 INTEGRATION OF SOLAR ARRAY AND POWER CONDITIONING ELECTRONICS. Springgate, W. F. (Boeing Co., Seattle). pp 850-68 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

This study was directed to increasing reliability and reducing the weight of high voltage solar-cell power systems for spacecraft. Conceptual designs of electrical configurations for a 15-kW, 2 to 16 kV, integrally regulated solar array were developed and evaluated for Earth orbit operation. Such an array could, for example, power ion thrustors on a satellite climbing to synchronous orbit, then power radio transmitting tubes. Concepts developed for integral power conditioning on the array are applicable to low voltage as well as high voltage solar arrays. The problems in developing these configurations, and the direction of work for solving these problems are defined. Providing for radiation degradation of solar cells results in an initial solar-array power capability which is nearly twice the final 15 kW. A switching approach involving a slight additional weight in the proposed array permits this extra initial power to be used in secondary loads. Computer directed switching adds trimmer blocks of solar cells to the primary blocks to maintain voltage and current despite temperature effects on the array, load variations, ionizing radiation degradation, and faults caused by micrometeoroids or failure of array elements. Other switching reconfigures the array, from an arrangement where six or more different primary loads are powered at differing voltages, to a final configuration which supplies a single 16 kV load. Voltage or current is regulated to within 0.1% by low-dissipation digital switching techniques. The switches are optically linked to control to isolate the high voltage from control circuits. Logic functions for array protection, regulation and reconfiguration are in a central computer. Both on-board and over-riding ground control are provided. Presently available solid-state devices could be used. However, the array versatility and performance are a strong function of the characteristics of the switching devices used. Gains in performance can be obtained by development of higher voltage switching transistors. Mathematical reliability models show that an array can be configured to achieve an estimated reliability of 0.99. Such an array would have higher reliability than conventional low-voltage arrays. A simplified electrical configuration was developed for applications where a 0.96 reliability is sufficient. A performance analysis shows that with an estimated reliability of 0.96 the high voltage array, complete with regulation and control, will generate power with a performance loss of only 1.4 watts/lb (4.5%) and 0.27 watts/ft^2 (3.0%) when compared with low-voltage roll-up array which has no provisions for power conditioning or damage control. Verification is required of the conceptual designs for regulation, switching, protection, and isolation of high and low voltage circuits. This verification consists of selection and test of components such as photo-SCR's and high voltage transistors, integration of these elements into hybrid thick and thin film circuits, and fabrication and test of breadboards. (auth)

56003 DESIGN AND FLIGHT RESULTS OF A SOLAR ARRAY/SILVER ZINC BATTERY POWER SYSTEM. Shaw, Gordon A. D. (Lockheed Missiles and Space Co., Palo Alto, Calif.). pp 869-80 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Agena satellite has been one of the workhorses of the United States space programs since 1960. More than 300 widely varied missions have been accomplished ranging from placing the lunar orbiter spacecraft into a moon orbit, to playing the role of an on-orbit target docking vehicle in the Gemini manned space program. The Agena in its role as a stable space platform requires many sophisticated support systems, such as guidance, telemetry and command subsystems. In order to service its primary mission, these systems all require electrical power. Several power systems have been developed to support the wide variety of space missions accomplished by the Agena. These include straight discharge batteries, nuclear power sources, radioisotope thermoelectric generators, and solar array systems. A continuing effort has been placed on improving this satellite's orbital capability to accommodate widely varying space missions active with increased power requirements. A reliable and low cost electrical solar array/primary battery power system is described. Since its components were essentially "off the shelf", the following advantages were obtained: total time span from component selection to flight test was 14 months; negligible development and qualification testing; and high probability of mission accomplishment due to past flight success. (auth)

56004 LONG-TERM PERFORMANCE OF LEAD TELLURIDE THERMOELECTRIC GENERATORS. Knudson, J. O. (Minnesota Mining and Mfg. Co., St. Paul). pp 979-84 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Reliable long-term performance of thermoelectric generators has now been demonstrated for operating periods exceeding six years. These generators use technology developed under SNAP-21, SNAP-23A, and SNAP-27 programs run under the direction of the USAEC. The technology includes the use of lead-telluride and lead-tin-telluride thermoelectric materials pressure-contacted at the hot junction and hermetically sealed in an enclosure filled with an inert cover gas. The information presented includes performance data from thermoelectric generators designed to supply electric power in underseas, terrestrial and space applications. (auth)

56005 RELIABILITY MODELING OF A LONG-LIFE RADIOISOTOPE THERMOELECTRIC GENERATOR. Bradshaw, George B.; Postula, Frank D. (Gulf Energy and Environmental Systems, Inc., San Diego, Calif.). Contract AT(29-2)-2617. pp 1003-9 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Application of radioisotope thermoelectric generators (RTG) for mission times of five years and beyond require sophisticated mathematical models to simulate expected performance profiles. A reliability model developed under the TRANSIT RTG Program simultaneously combines all the system degradation mechanisms that influence end-of-mission (EOM) power output. The model is unique in that it mathematically synthesizes all of the RTG performance parameters, treating thermoelectric properties and data scatter for each material separately and using regression analysis to extrapolate beyond current test times of 20,000 h. A probability density function of EOM power is determined from a Monte Carlo random statistical sampling procedure. Although the model was developed primarily to estimate the probability of the TRANSIT RTG delivering 30 W after five years in space, the developmental methods are recommended for other long-life RTG systems. Also presented are the probabilities of generator failure associated with other RTG failure modes. (auth)

56006 ORBITAL PERFORMANCE OF THE SNAP-19 RADIOISOTOPIC THERMOELECTRIC GENERATOR EXPERIMENT. **Fihelly, Arthur W. (Goddard Space Flight Center, Greenbelt, Md.); Baxter, Charles F. pp 1163-83 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The Nimbus III/SNAP-19 launch on 14 April 1969 represented the first flight of a nuclear power supply on a NASA observatory. The SNAP-19 nuclear power supply consists of two generators, two dc-dc converters, and a telemetry signal conditioning unit (TSCU). Power is produced by converting the heat of decay of the radionuclide ^{238}Pu in a static thermopile consisting of 90 2n-3p PbTe couples per generator connected in three parallel strings. SNAP-19 S/N 009 produced 49.20 watts of usable power at launch and has degraded to 30.46 watts after twenty-two months in orbit, which represents a higher than anticipated degradation rate based on testing prior to launch of the same thermopile technology in electrically heated generators and module boxes. Hot/cold junction temperatures have increased by approximately 21 to 25°F during this period, while fin root temperatures have gone through two 3 to 5°F increasing-decreasing cycles directly related to solar energy flux variations in orbit. Hot junction temperature rise over the past five months is exactly that predicted by loss of Peltier cooling due to generator current decay, indicating that a condition of relative equilibrium has been established in the mix of fill gases within the generators. The time rate of loss of power output capability has markedly accelerated for both generators since the fifteen-sixteen months period, indicating that the inherent degradation mechanisms present within S/N 009 flight hardware are accelerating in effect with time. The hypothesized reason for the observed S/N 009 power output vs time characteristic is a gradual evolution of oxygen from the PuO_2 "microsphere" fuel form at operating temperatures, and the diffusion of a portion of this evolved oxygen from the vented heat sources into the SNAP-19 internals. Leakage of generator fill gas (argon, plus the helium normally vented from the heat sources) has resulted in a pressure drop from 15.5 psia soon after launch to an "indicated" (—)1.00 psia, the lower response limit of this telemetry channel, since early January, 1970. However, a detailed analysis by NASA and the AEC of the generator temperature data during the first twenty-three months of orbital operation supports the belief that substantial fill gas pressure still remains, in lieu of reliable pressure transducer telemetry information for either generator. Generator output currents have decayed as generator internal resistances have increased with time, generator output voltages being effectively "clamped" by the Nimbus II regulated bus. (auth)

56007 LONG TERM BEHAVIOR OF SNAP-19 GENERATORS WHICH USE THE TAGS THERMOELECTRIC MATERIAL. **Stapfer, G.; Truscello, V. (California Inst. of Tech., Pasadena). pp 1184-8 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The life test results obtained at JPL from a SNAP-19 "TAGS" thermoelectric generator are discussed and analyzed. This generator has been tested for ~10,000 h at an average hot junction temperature of 1015°F in an argon environment. The generator output power had degraded at an average rate of 0.5%/1000 h during this test period. A comparison of the data with identical generators being tested by the manufacturer but at different temperatures was made. With this data, a typical generator degradation rate as a function of operating temperature was established. A long term (~5 y) generator performance prediction was made based on the available experimental data, including the effects of thermoelectric material changes as well as isotope fuel decay. (auth)

56008 SNAP-19 RADIOISOTOPE THERMOELECTRIC GENERATOR THERMAL/ELECTRICAL INTEGRATION WITH THE VIKING MARS LANDER. **Brittain, Wayne M. (Teledyne Isotopes, Las Vegas, Nev.). pp 1189-99 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Application of Radioisotope Thermoelectric Generators (RTG's) to the Viking-75 Mars soft-lander mission presents a significant challenge in the areas of thermal and electrical integration. The wide variation in thermal environments experienced during the mission phases directly influences the electrical power profile for the RTG's. Due to planetary quarantine requirements for microorganisms, fueled RTG's will be sterilized for the first time, along with the lander, while contained in a biocanister. After sterilization, the lander and RTG's will remain enclosed in the biocanister during subsequent ground operations, launch and interplanetary cruise. In Mars orbit the biocanister will be ejected prior to entry. During entry and after landing on the Martian surface, the RTG's will provide the prime electrical power source for the lander scientific instruments. Additionally, after landing, the RTG's will function as heat sources for thermal control of the lander during diurnal cycling and high velocity cooling winds. (auth)

56009 SNAP-19 HIGH PERFORMANCE GENERATOR (HPG) DEVELOPMENT FOR ADVANCED SPACE MISSIONS. **Christenbury, S. T.; Dick, P. J. (Teledyne Isotopes, Las Vegas, Nev.). pp 1200-9 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

An up-rated SNAP-19 Radioisotope Thermoelectric Generator (RTG) is being developed for Advanced Space Power requirements. This High Performance Generator (HPG) advances the RTG state-of-the-art by incorporating design improvements into existing isotopic heat source, thermoelectric, and materials technology. Enhanced performance, higher power-to-weight ratio, is obtained without establishing a requirement for significant development efforts and costs. Design optimization studies have been completed and detailed engineering design established. The HPG utilizes the SNAP-19 Pioneer/Viking RTG design concepts. SNAP-19 HPG is designed to convert the decay heat of a ^{238}Pu isotopic heat source into sixty-five watts of electrical power utilizing lead telluride and silver antimony germanium telluride as the conversion materials. The radioisotopic heat source consists of a three-layer tantalum alloy cylindrical fuel capsule contained within a hexagonal graphite heat shield. The fuel capsule component parts are the same as the SNAP-19 PIONEER and VIKING fuel capsules with increased length to accommodate additional ^{238}Pu fuel requirements. The graphite heat shield has increased thickness above the Pioneer and Viking designs to provide the capability of additional reentry protection and increased aerospace nuclear safety margin. The increased heat shield envelope can also be used for added heat source flexibility if improved heat source technologies are developed prior to application of SNAP-19 HPG to advanced missions. The thermoelectric converter and heat source are contained within a magnesium—thorium alloy housing having six tapered heat rejection fins opposite the six thermoelectric modules. The generator is enclosed on the ends by magnesium thorium alloy end covers which are welded into the housing by the use of a structural shear weld. A design description, weight summary and predicted electrical performance for space missions are presented. A comparison of these performance parameters with the SNAP-19 Pioneer RTG performance parameters shows the enhanced performance of the HPG generator. (auth)

56010 ENVIRONMENTAL ASPECTS OF MHD POWER GENERATION. **Bienstock, D.; Demski, R. J.; Demeter, J. J. (Bureau of Mines, Pittsburgh). pp 1210-17 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).**

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Emissions of sulfur oxides and nitrogen oxides can be substantially reduced in MHD power generation through seed regeneration and 2-stage combustion. Pulverized coal, flowing at 120 to 200 lb/hour, was burned in a cyclone furnace at 4000 to 4200°F with oxygen-enriched air and seeded with potassium carbonate. At 0.9 g mole K_2CO_3/kg coal, 99% removal of SO_2 was obtained. The sulfur of the spent seed-fly ash mixture was completely recovered as H_2S by treating with $H_2 + H_2O$ at 1530°F. In 2-stage combustion with 94% of stoichiometric air to the combustor and additional air injected at 2450°F to bring the total combustion air to 107% of stoichiometric, NO_x emissions were lowered to 550 ppM or 0.40 lbs $NO_2/10^6$ Btu input. (auth)

56011 EFFECT OF SERIES RESISTANCE ON THE PERFORMANCE OF SILICON SOLAR CELL AT LOW INTENSITIES. Rao, B. A. Bhaskara; Nath, Prem (Indian Inst. of Tech., New Delhi). Indian J. Phys.; 45: No. 12, 543-9(Dec 1971).

It is well known that in the intensity range ($\simeq$140 MW/cm^2) encountered in the outer space applications, the series resistance drastically affects the maximum power output of a solar cell. The effect of series resistance on the maximum power output of a silicon solar cell in the intensity range $\leq$100 MW/cm^2 was investigated. It was found that sensitivity of the maximum power output of a solar cell to series resistance falls significantly as intensity decreases. Thus somewhat higher series resistance seems to be tolerable without a serious loss in power output at low intensities. (auth)

Facilities and Equipment

Refer also to abstracts 55978 and 55997.

56012 (DP-1297) DEEP-BED FILTER PERFORMANCE TESTS. Schurr, G. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Jul 1972. Contract AT-(07-2)-1. 27p. Dep. NTIS.

Comparative tests of filtration efficiency and particle holding capacity of sand and Fiberglas filters have been performed. Filters tested were modeled after designs currently in use at the Savannah River Plant and Hanford Works. The test program included: efficiency determinations of sand and "Fiberglas" filters using accepted DOP aerosol testing techniques routinely used for the efficiency determinations of HEPA filters, efficiency evaluation of specific sand deposits, and simulated smoke loading of both the sand and Fiberglas units. The tests have provided engineering data on filter performances, specific sand efficiencies, filter safety, and costs. (auth)

56013 (ORNL-TM-3420) BLOWTHROUGH EXPERIMENTS ON THE OSW WRIGHTSVILLE BEACH 3-STAGE FLASH EVAPORATOR, AUGUST 1970. Delene, J. G.; Ball, S. J.; Clapp, N. E. Jr. (Oak Ridge National Lab., Tenn.). Oct 1972. Contract W-7405-eng-26. 61p. Dep. NTIS.

A series of tests was run on a 3-stage experimental flash evaporator at the Office of Saline Water Test Station at Wrightsville Beach, North Carolina in August 1970. Those portions of the tests in which the evaporator was in the blowthrough mode of operation is discussed. Some observations are made on the operating characteristics in the blowthrough mode and the transitions into and out of this mode. Explanations for some of the plant blowthrough behavior are presented. (auth)

56014 (UR-3490-127) EVALUATION OF AN EXPLODED-WIRE AEROSOL GENERATOR FOR USE IN INHALATION STUDIES. Phalen, Robert F. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 36p. Dep. NTIS.

An exploded wire aerosol generator was evaluated using test aerosols derived from silver wires and results were compared to existing published information on exploded wire particles. Aerosol properties relevant to inhalation studies were emphasized. Primary particles were spherical, metallic, and distributed nearly lognormally by mass (geometric standard deviation about 1.5) with count median diameters between 0.05 and 0.008 μ. The primary particle size decreased as the explosion energy per unit mass of wire was increased. Primary particles rapidly formed agglomerates of up to hundreds of spherical units but an air blast aimed at and synchronized with the wire explosion was successful in reducing agglomeration. Agglomerate aerosols with submicron aerodynamic diameters were produced by rapidly diluting the explosion zone after the air blast. Agglomerates of 0.026 μ count median diameter primary particles had measured specific surfaces of 16.4 m^2/g and solubility rate constants of 10 $\mu g/cm^2$/day in a lung fluid simulant containing protein. The relevance of exploded wire agglomerates to inhalation studies is briefly discussed. (auth)

56015 SYNTHESIS OF THE RESULTS OF 10 YEARS WORK ON HEAT EXCHANGER TESTING. LIST OF CONTROLLED PERFORMANCE. Fremaux, L.; Korek, L.; Llory, M. (Electricite de France, Paris). Bull. Dir. Etud. Rech., Ser. A; No. 1, 77-95(1972). (In French).

The development of large-scale testing rigs for the components of magnox-type power stations is described. The Joule heating (30,000 kW) of the loop number 2 facilitated the full-scale testing of exchanger prototypes. The operating conditions and the measurement systems are briefly described; the main results obtained by testing the steam generator units intended for either the magnox-type power stations or the heavy water moderated gas cooled power station of Monts-d'Arree are given. (France)

56016 DEVELOPMENT PROGRAM CONCERNING HIGH-EFFICIENCY GAS TURBINES. Deut. Forschungsdienst, Sonderber. Kernenerg.; 16: No. 13, 62-3(1971). (In German).

The explanation of the advantages of a gas turbine, coupled with the helium-cooled HTR, is followed by the description of main objectives of the development program. (INIS)

56017 VISCOSEALS FOR SODIUM PUMPS. Bussemaker, E. J. (Koninklijke Machinefabriek Stork N.V., Hengelo, Netherlands); Hirs, G. G. Polytech. Tijdschr., Procestech.; 27: No. 16, 524-9(2 Aug 1972). (In Dutch).

Viscoseals have been designed and tested for use in liquid sodium circulation pumps. This type of shaft seal, which prevents the escape of radioactive protective gas past the shaft, permits a thick film of oil to be applied between the running faces, ensuring a long service life. In tests covering speed, gas, atmospheric pressure, temperature, oil leakage to the gas side and the atmosphere, these seals did not show any oil leakage and were found to be sufficiently gas-tight. (auth) (Netherlands)

56018 PRESENT STATE AND FURTHER TENDENCIES IN THE DEVELOPMENT AND CONSTRUCTION OF COOLING TOWERS. Henning, H. (Maschinenbau AG, Bochum, Ger.). Tech. Mitt.; 65: No. 2, 53-9(1972). (In German).

The present state of cooling tower engineering is discussed. The physical behavior and possible technological improvements in cooling towers are given. Mainly the problems of wet-cooling towers are dealt with. (GF)

56019 ITALIAN NUCLEAR ACTIVITY IN 1971. Battistini, G. Com. Naz. Energ. Nucl., Notiz.; 18: No. 7, 17-27(Jul 1972). (In Italian).

The nuclear activities carried out in Italy by CNEN, ENEL, and the nuclear industry during 1971 are reviewed. (auth)

56020 EFFECTS OF STEP-TYPE MAGNETIC FIELD IN SLIDER BEARING. Rodkiewicz, C. M.; Anwar, M. I. (Univ. of Alberta, Edmonton). Wear; 21: 223-9(1972).

The effects of step-type applied magnetic field on the load capacity, the frictional force, and the friction factor of a slider bearing were investigated analytically. The results indicate that highest load capacity is obtained for a given Hartmann number when the ratio of film thickness at inlet to outlet is optimized. (auth)

56021 FESTIGKEIT IM APPARATE- UND ANLAGENBAU. FESTIGKEITSBERECHNUNG UND KONSTRUKTION VON ELEMENTEN DES APPARATE- UND ANLAGENBAUES UNTER BESONDERER BERUECKSICHTIGUNG DES DAMPFKESSEL- UND REAKTORBAUES. (Strength in the Manufacture of Apparatus and in Plant Construction. Strength Calculations and Construction of Components in the Manufacture of Apparatus and Plant Construction under Special Considerations of Steam Boiler and Reactor Construction). Klapp, E. Duesseldorf; Werner (1970). 383p.

The book deals with strength calculations of components in the manufacture of apparatus and in plant construction and is intended to serve as a means for simplifying the calculation, design, and construction of apparatus and, to a minor extent, of machines in process technology and in chemical engineering. Emphasis is given to the basic element in the manufacture of apparatus and in high-pressure technology, with other components directly connected to it, such as flat and curved heads, flanges, bellows, etc., being considered in some detail. Special attention is given to solid-wall and to multi-layer containers. The sections devoted to thermal stresses and problems of vibration and stability will contribute to closing a gap in the literature available so far in this field. References pointing to the field of nuclear technology are aimed at underlining common features of this field and of the manufacture of apparatus and plant construction in both chemical engineering and in conventional power plant construction, and at revealing basic problems by means of a systematic literature evaluation, yet without going into detail. Each section is accompanied by a survey of recent publications in the particular field, indicating new research results, objectives, and principal items of development work. Some of the numerical procedures which are now making way in the manufacture of apparatus are given. Finally, methods of load and stress analysis are discussed and also aspects and problems pertaining to the combination of the various components to form an operable unit. (GF)

56022 IMPROVED PARASITIC SPEED CONTROLLERS FOR SPACE POWER SYSTEMS. Wimmer, H. L.; Ingle, B. D. (Lewis Research Center, Cleveland). pp 394-402 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The dynamic space power systems under investigation use parasitic speed controllers to regulate the rotational speed and frequency of the alternators. The speed controller regulates speed by applying an increasing parasitic load whenever the useful load is decreased and speed increases. The performance of present controllers employing phase-controlled loading has met major design goals, and the controllers have operated successfully in various systems for many thousands of hours; however, these controllers have performance characteristics which could be improved such as the reduction or elimination of: distortion of the line voltage; high neutral currents; additional volt-ampere loading on the alternator; unbalanced loading of the three phases, and nonlinearity of the control characteristic. Modifications of control logic are being investigated as ways to improve these characteristics. A modification being investigated is an increase in the number of stages for a given load range with each stage controlling a reduced amount of parasitic load. Other modifications include the addition of active nonlinear networks and power feedback networks. A design employing only digital circuitry is also being investigated. With this approach, a discrete amount of parasitic load would be varied for a discrete change in frequency. These design concepts are discussed and evaluated. The largest improvement in the electrical performance characteristics of these power systems is obtained by using an all-digital speed controller. However, the digital speed controller requires the use of a relatively large number of parasitic load elements. When only a few load elements are available, significant improvements in the performance characteristics can be obtained by using suitably modified existing speed controllers. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 55958, 56015, 56640, 58047, 58052, 58384, 58399, 58400, and 58402.

56023 (FRNC-TH-231) HEAT EXCHANGE PROCESSES IN EXCHANGER MATERIALS. HIGH TEMPERATURE HEAT TRANSFER EQUIPMENT. Yerouchalmi, David (Lille Univ., Villeneuve-d'Ascq (France)). 1972. 187p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

High-temperature heat exchange processes in a tubular metallic exchanger and in an exchanger which stores heat on a bed of moving pebbles were studied in the framework of a research program involving the 3 MW MHD energy conversion installation at Swierk (Poland). Refractory materials, resistant to alkaline corrosion and to grain growth, were developed as coating materials for both types of exchangers. Useful sintered materials were also developed. An original pebble bed-type exchanger heated by radiation and provided with distributors and valves, which retain their fluid tight properties at high temperatures, is proposed. This type of exchanger would have numerous advantages over those currently used. (France)

56024 (RFP-1782) FORTRAN PROGRAM FOR CALCULATING THE TEMPERATURE DISTRIBUTION RESULTING FROM VOIDS IN LAMINATED STRUCTURES. Lassahn, Gordon D.; Dixon, Raymond D. (Dow Chemical Co., Denver, Colo. Rocky Flats Div.). 10 Aug 1972. Contract AT(29-1)-1106. 11p. Dep. NTIS.

Described is a FORTRAN time-sharing program that calculates the steady-state temperature distribution resulting from heat flowing around a void at the interface of a two-layer metal structure. One exterior surface of the structure is heated, and the heat is conducted through the metal plates and across the metal-metal interface to the opposite exterior surface, where the heat is dissipated to the air. The void at the interface is a rectangular cross-section slot in one of the metal plates. The conductivities of the two metals and of the interface, the dimensions of the plates and of the slot, and the boundary temperatures are variable. A sample calculation is presented. (auth)

56025 (SCL-DR-720024) SAHARA: A MULTIDIMENSIONAL HEAT-TRANSFER COMPUTER CODE (USER'S MANUAL). Gabrielson, V. K. (Sandia Labs., Livermore, Calif.). Sep 1972. Contract AT(29-1)-789. 88p. Dep. NTIS.

Numerical techniques and inputs are described for the SLL multidimensional heat transfer computer code SAHARA. SAHARA is used to determine the steady state and transient solutions to problems involving complex structures which must be modeled in two or three dimensions. Features of the code include the capability to handle very general nodal networks with variable boundary conditions and variable material properties. A radiosity method is used in SAHARA for radiation heat transfer within enclosures of a thermal model. Also available is the option of using an implicit or explicit solution for the heat transfer equations. For those cases in which the structure is symmetric about one axis, the HEATMESH computer code is used to generate the required geometrical information for the SAHARA code. (auth)

56026 (SFB-MHD-3) THEORETICAL INVESTIGATION OF THE TEMPERATURE DISTRIBUTION IN A Na-K COUNTER FLOW HEAT EXCHANGER WITH LIQUID REVERSAL. Meier, S. (Technische Universitaet, Berlin (West Germany)). Feb 1971. 65p. (In German). Dep. NTIS (U. S. Sales Only).

For calculating the distribution of temperature in a Na-K counterflow heat exchanger an ALGOL-program was written including the dependency of physical properties and heat transfer coefficient from temperature. The inlet temperature of the potassium and the sodium flow rate were varied in a wide range. The results indicate an agreement between the calculated performance and the demand for the heat power of 0.5 MW. A reduction of the sodium flow rate from 130 g/s to 85 g/s for checking the materials strength is proposed. (auth)

56027 (SU-326-P-13-6) STUDY OF RADIATION-INDUCED NUCLEATION OF BUBBLES IN SUPERHEATED LIQUIDS. Progress Report. Christensen, R. N.; Pilati, D. A.; Whitehouse, H. T.; Connolly, T. J. (Stanford Univ., Calif. Nuclear Engineering Div.). 15 Jan 1972. 31p. Dep. NTIS.

Effort during this period was directed to measurements of bubble nucleation caused by the products of the $^{10}\mathrm{B}(n,\alpha)^{7}\mathrm{Li}$ reaction. While definite evidence of nucleation was observed, precise measurements of the threshold conditions were hindered due to high bubble background (i.e., bubbles nucleated in the absence of radiation). The preliminary data gathered under these circumstances are presented. High background is thought to be due to dissolved gas; recent system modifications have been directed to lowering bubble background. The experimental scope of the project has been broadened by the inclusion of ethyl alcohol as a nucleating medium. Ethyl alcohol (critical temperature 470°F, critical pressure 926 psia) is sensitive to the $^{10}\mathrm{B}(n,\alpha)^{7}\mathrm{Li}$ reaction products. Nucleation has been achieved at temperatures and pressures which place less strain on the bubble chamber than when water is used. Work on bubble-growth phenomena, aided by high-speed motion pictures, has continued. A neutron shutter has been designed and fabricated to provide short bursts of neutrons. The objective is to provide a well-defined, short interval of time during which a bubble is nucleated. Knowledge of the bubble nucleation time is important for bubble-growth studies. Theoretical threshold predictions in water were modified to include recently published surface-tension and stopping-power data for liquid water. These data lead to predictions of higher nucleation thresholds. Similar computations were performed for ethyl alcohol. Several significant modifications to the bubble chamber and the ancillary equipment have been made. (auth)

56028 CONCEPT OF DIAPHASE RESISTANCE. APPLICATION TO CAVITATION AND BOILING. Bonnin, J. (Electricite de France, Paris). Bull. Dir. Etud. Rech., Ser. A; No. 1, 39-76(1972). (In French).

The thermodynamic parameters determining the heat necessary to vary the volume of gas pockets in cavitating or boiling liquids can be expressed in terms of a single thermodynamic parameter: the diaphase resistance. The range of values capable of being assumed by this parameter are studied. The comparison of this parameter with the thermal conductivity and the specific heat lead to the previously introduced concepts of a characteristic time and a characteristic pressure. This thermodynamic quantity can be decomposed into two terms: a constant term depending only on the fluid, and a universal function of nondimensional temperature. The most interesting results are shown in tables and graphs. (France)

56029 TEPLOOBMEN, GIDRODINAMIKA I TEPLOFIZICHESKIE SVOISTVA VESHCHESTV. (Heat Transfer, Hydrodynamics, and Thermophysical Properties of Matter). Alad'ev, I. T. (ed.). Moscow; Izdatel'stvo Nauka (1968). 280p.

The three major divisions of this volume are hydrodynamics and heat exchange of two-phase currents; convective, radiational and complex heat exchange; and thermophysical properties of matter. The latter section includes radiative properties of Ta, Mo, Nb, NbC, and graphite, and photographic methods of studying emissivity. Critical regions of water boiling in rod bundles, the thermodynamics of MHD devices, a literature survey on heat exchange during the flow of a conducting fluid in a magnetic field, and various parameters of the working fluids of MHD generators are other topics of especial interest. (K.S.W.)

Materials Testing

Refer also to abstracts 55980, 56284, 56314, and 56850.

56030 (CONF-720704–1) HETEROGENEITY OF FUSION WELDS DETERMINED BY USE OF ^{63}Ni-TAGGED FILLER METAL. Hammond, J. P.; Slaughter, G. M. (Oak Ridge National Lab., Tenn.); Gurtner, F. B. (Edgewood Arsenal, Md. (USA)). [nd]. 35p. Dep. NTIS.

From Symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972).

Methods were developed for adding low-energy-level radioactive tracers to filler wires for studying weld-associated features such as cracking, dross formation, segregation, and incomplete alloying between base and filler metals. All of these have caused concern in a wide variety of materials used in commercial products. For stainless steels and high-nickel alloys, two types of radioactive tracers were used for analyzing these problems: (1) a tracer (^{63}Ni) that dissolves homogeneously in the filler metal and thereby enables examination for cracks, porosity, surface dross, and alloying in the weld deposit; and (2) tracers (^{14}C, ^{35}S, and ^{33}P) that form segregates that could lead to weld cracking, low ductility, or selective corrosion. The radioactive isotopes selected are all pure beta emitters whose rays have low energy (all <0.25 MeV). This type of tracer enabled examination of the metallurgical features by autoradiography with minimum film fogging and maximum resolution. Alloying between base metal and filler metal, dross formation, and weld cracks was clearly delineated in stainless steel and high-nickel alloys, and the discrete microstructural regions were readily appraised. Whereas a high concentration of filler metal on the bottom side of root passes of multipass welds is generally sought to avoid cracking, the weld deposit in this region in some instances was essentially devoid of filler metal. Also, contrary to the widely held view that weld deposits are essentially homogeneous mixtures between filler metal and base metal, large compositional differences were found along fusion lines where base metal was concentrated within the deposit. (auth)

56031 (JAPFNR–26) SODIUM COMPONENTS AND MATERIALS TESTING FACILITIES. Revised. (Power Reactor and Nuclear Fuel Development Corp., Oarai (Japan). Oarai Engineering Center). Translation of a Japanese report. 29p. (PNC-N–141-72-1-18). Dep. NTIS (U. S. Sales Only).

A general description of the facilities is presented. Descriptions are included on buildings, test loops, and equipment. (J.R.D.)

56032 (JAPFNR–45) EDDY CURRENT INSPECTION OF FUEL CLADDING TUBES. (Sumitomo Metal Industries Ltd., Osaka (Japan)). Translation of a Japanese report. 16p. (PNC-N–141-72-1-16). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan).

Inspection of stainless steel cladding tubes of 6.3 mm OD and 0.35 mm wall thickness was investigated using a NORTEC ECS–4 eddy current tester. The eddy current instrument was calibrated by a standard tube containing longitudinal artificial flaws 25 μ deep on outer and inner surfaces. Tubes inspected by the eddy current tester were tested by an ultrasonic flaw detector. The wall thickness was measured by an ultrasonic gage and the inner diameter by an air micrometer. It was found that the flaws which are difficult to detect using an ultrasonic flaw detector due to its shape and location were detected by the eddy current tester. Surface defects, variation in wall thickness, and effects of abrasion on surfaces were detected by eddy current inspection. (auth)

56033 (SCL-RR–720060) CRITICAL MODE NUMBER STUDY OF A DYNAMICALLY BUCKLING RING. Wesenberg, D. L.; Birnbaum, M. R. (Sandia Labs., Livermore, Calif.). Sep 1972. Contract AT(29-1)-789. 40p. Dep. NTIS.

An analysis is made of the dynamic buckling of a thin ring in the elastic–plastic range, by means of the Hamilton–Reissner Variational Principle, deformation theory, and a Ramberg–Osgood stress–strain representation. The resulting equations of motion are then simplified and solved to obtain an expression for the critical mode number and a graphic stability–instability relationship for a dynamically excited ring. (auth)

56034 (UCRL–51250) CALCULATING STRESSES IN A PRESSURE VESSEL WITH FILL TUBE: COMPARISON OF THE FINITE ELEMENT AND PHOTOELASTIC METHODS. Blum, R. E.; Kirkwood, W. F. (California Univ., Livermore. Lawrence Livermore Lab.). 30 Jun 1972. 22p. Dep. NTIS.

The stresses were calculated in an elastic solid by both the finite element and photoelastic methods. The problem chosen was stress under pressure loading near a pressure-vessel/fill-tube interface, where large stress gradients are present. The two methods gave essentially the same results except in regions of extremely large stress gradients, where the fringes for the photoelastic model were very difficult to separate. (auth)

56035 CONVERTER THICKNESS FOR OPTIMUM INTENSITY IN NEUTRON RADIOGRAPHY. Muellner, M.; Jex, H. (Univ., Frankfurt am Main). Nucl. Instrum. Methods; 103: No. 2, 229-33 (1972).

The thicknesses of converter screens such as plastic scintillators, glass scintillators, and metal foils were experimentally determined and calculated for optimum intensity in neutron radiography. The data are compared with experimental results of several laboratories. Summarizing tables and drawings are given. (auth)

56036 NEUTRON RADIOGRAPHY IN THE SERVICE OF NONDESTRUCTIVE MATERIALS TESTING. Alexander, W. Konstr. Elem. Method.; 7: No. 6, 93(1970). (In German).

The principles of neutron radiography and its applicability are briefly discussed. The British Center for Nondestructive Materials Testing in cooperation with AERE (Harwell) offers a neutron radiography service with a ^{124}Sb–Be source. (INIS)

56037 METRIC PRACTICE GUIDE. E 380-1972. Philadelphia; American Society for Testing and Materials (1972). 34p.

Units for conversion of quantities in various systems of measurement to the International System of units are tabulated. The system is officially abbreviated SI in all languages. (J.R.D.)

56038 SIMPLIFIED HYBRID DISPLACEMENT METHOD APPLIED TO PLATE BUCKLING PROBLEMS. Kikuchi, Fumio; Ando, Yoshio (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 8, 497-9(Aug 1972).

Formulation of plate buckling problems is examined using the simplified hybrid displacement method. The applicability of this method is demonstrated by numerical methods. A practical modification of the method is also described. (J.R.D.)

Nuclear Explosions

Refer also to abstract 56118.

56039 (BMI–171-147) BIOENVIRONMENTAL SAFETY STUDIES, AMCHITKA ISLAND, ALASKA. CANNIKIN D+2 MONTHS REPORT. Amchitka Bioenvironmental Program. Kirkwood, James B.; Fuller, R. Glen (comps.) (Battelle Columbus Labs., Ohio). Jun 1972. Contract AT(26-1)-171. 100p. Dep. NTIS.

A preliminary evaluation of studies of the effects of Cannikin on the Amchitka ecosystems shows that individuals of several species of marine mammals, waterfowl, and marine and freshwater fish were killed by the test, but no animal population on or around the Island was jeopardized. The effects of Cannikin on geomorphic features were considerably greater than had been predicted. Coastal rockfalls and turf slides on the Bering Sea coast adjacent to Cannikin were extensive. (D.H.M.)

56040 (COO–2138-9) SEISMOLOGICAL AND RELATED EFFECTS OF THE CANNIKIN UNDERGROUND NUCLEAR EXPLOSION. Final Report. Willis, D. E.; George, G.; Poetzl, K. G.; Saltzer, C. E.; Shakal, A. F.; Torfin, R.; Woodzick, T. L. (Wisconsin Univ., Milwaukee. Dept. of Geological Sciences). Jul 1972. Contract AT(11-1)-2138. 152p. Dep. NTIS.

The geological and geophysical effects of the Cannikin underground nuclear shot which was detonated under Amchitka Island on November 6, 1971 are reported. Seismological data of the World Wide Standard Seismograph Network and the Canadian Network showed that the shot had a body wave magnitude of 7.0 (NOS determined 6.8 on the basis of WWSSN data) and a surface wave magnitude of 5.7. There is evidence which indicates tectonic strain may have been released at the time of the shot and at approximately 5 to 6 minutes following the shot. However, in both cases the seismic energy of the tectonic events was smaller than the seismic energy generated by the shot. The shot did not cause a tsunami and did not noticeably affect the pattern of naturally-occurring earthquakes at local, regional or teleseismic distances. Anomalously large seismic surface waves observed in the Canadian Shield area are interpreted as being due to either lower attenuation losses in shield-type rock, source radiation effects, channeling of seismic waves along the Aleutian Arc, percentage of continental path traversed by the waves, or a combination of these effects. Strain meter measurements, geodetic data, geomagnetic data and geological observations show that there were permanent changes in the stress/strain field in the earth's crust due to effects of Cannikin. However, these are restricted to a relatively small area and are not believed to significantly influence the pattern of naturally-occurring earthquakes. (auth)

56041 (FOA-4-4503) HAGFORS OBSERVATORY 1971, ANNUAL REPORT. Dahlman, Ola; Israelson, Hans; Hoernstroem, Gunnel; Lindh, Bryant; Moeller, Birgitta; Nedgard, Ingvar; Nordgren, Leif; Slunga, Ragnar; Soederstroem, Boerje (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Sep 1972. 44p. Dep. NTIS (U. S. Sales Only).

The work done at the Hagfors Observatory in 1971 is summarized. The recording station at Hagfors has been in continuous operation throughout the year and the shut-down time has decreased compared to 1970. Seismic signals have been recorded from 28 announced or presumed nuclear explosions, two of which have not earlier been reported. Event locations have routinely been carried out at the Observatory and 133 earlier events located that were not previously reported. An algorithm for the location of local events with an accuracy of about 5 km was developed. Beam forming of long- and short-period signals has been used as a way of increasing the long- and short-period detection capability. The HFS short-period discrimination capability for events in Eurasia was studied, using both simple discriminants, e.g., complexity, spectral ratios and TMF, and more complex multidimensional discriminants. The short-period discrimination capabilities were compared with those obtained from available $m_b(M_s)$ data. The short-period discriminants were used in a classification experiment where 87% of the explosions were correctly classified and 4% of the earthquakes were misclassified. A joint Canadian–Swedish short-period multistation discrimination study of Eurasian events has started. The confidence limits of identification curves were studied by computer simulation. The Observatory has participated in an increased international exchange of seismological data. (auth)

56042 (JAB-99-101) PRODUCTION OF TIME DEPENDENT RESPONSE AND BAND PASS FILTER SPECTRA. Schopp, K. F.; Scholl, R. E. (Blume (John A.) and Associates Research Div., San Francisco, Calif.). Sep 1972. Contract AT(26-1)-99. 38p. Dep. NTIS.

The computer processing procedures developed for the production of an initial series of Response Envelope Spectra (RES) and Seismic Signals in Frequency and Time (SSIFT) plots are described. Absolute envelopes of response (RES) and band pass filter (SSIFT) time-histories are plotted in contour map plots and three-dimensional profile plots for a variety of seismic disturbances. The complete study produced 31 map sets (28 RES sets, 3 SSIFT sets) of which 5 sets (4 RES sets and 1 SSIFT set) are contained in the report. The purpose of the study was to produce typical examples of the methods of displaying data to aid in the evaluation of their usefulness. (auth)

56043 (SC-RR-720529) SEISMIC SOURCE ENERGIES OF FOUR EXPLOSIONS IN A SALT DOME. Perret, William R. (Sandia Labs., Albuquerque, N. Mex.). Sep 1972. 15p. Dep. NTIS.

Free-field ground motion induced by four explosions within the Tatum Salt Dome in Mississippi was recorded by a single set of six shot-level instrument stations installed within the dome. The four explosions, all within the salt at approximately the same elevation, ranged from a 5.3-kiloton tamped nuclear event to a 2.7-ton nitromethane detonation. Energies associated with free-field motions observed at the various stations have been calculated and compared with that released by each event. Those calculated energies which were derived from data considered to have been acquired from within the seismic region surrounding each event have been compared either as individual stations or as means for several stations. The latter comparison indicates that the Sterling decoupled nuclear event was in fact decoupled by a factor of about 100 to 150 from the fully coupled Salmon nuclear explosion; that the seismic source energy of the tamped chemical explosion, Sterling HE, was roughly equivalent to that of tamped nuclear explosions in hard rock; and that seismic source energy of Diode Tube, the detonable gas explosion designed to be comparable to the Sterling nuclear one, was in fact lower than that of Sterling by a factor of nearly 15. (auth)

56044 (UCRL-51262) ESTIMATING THE FISSION YIELD OF FREE-AIR NUCLEAR DETONATIONS FROM DEBRIS-CLOUD SAMPLING MEASUREMENTS. Crandall, W. K.; Crawford, T. V. (California Univ., Livermore. Lawrence Livermore Lab.). 25 May 1972. Contract W-7405-eng-48. 8p. Dep. NTIS.

To obtain rapid and reasonably accurate estimates of the fission yields of free-air nuclear detonations from in-cloud sampling measurements, two nomograms were prepared. The nomograms, drawn for a unit yield, employ mean cloud sizes and constant meteorology, and apply to times of 10 to 100 h after detonation. Output from the large-cloud diffusion code 2BPUFF was used in the preparation of the nomograms. The nomograms consider samples of gross fission products, in which case a $t^{-1.2}$ radioactive decay law is assumed, and nondecaying (or decay-corrected) radionuclide samples. Required inputs to the nomograms are mean wind speed, mean cloud-center height, total estimated yield (fission plus fusion) of the nuclear device, and time after detonation when measurements are taken. The fission yield is then determined by comparing measured in-cloud concentrations with the nomogram-calculated concentrations. Fission yields determined from the nomograms are believed to be accurate to within a factor of 2 to 3. (auth)

56045 (UCRL-Trans-10615(Pt.1)) RESEARCH ON GEOLOGIC EFFECTS OF UNDERGROUND NUCLEAR EXPLOSIONS IN A SAHARA GRANITE MASSIF. Faure, Jean. Translated for Univ. of California Lawrence Livermore Lab., from Recherches sur les Effets Geologiques d'Explosions Nucleaires Souterraines Dans un Massif de Granite Saharien. 72p. Dep. NTIS.

Main results are reported of geologic studies carried out on underground nuclear explosions in a Haggar granite massif. The work is divided into three parts. The first part consists of a relatively brief study of the test site. Part 2 consists of an analysis of a number of specific geologic problems related to underground nuclear explosions, including descriptions of surface damage, fracturing observed in boreholes by television, permeability measurements, and mineralogical transformations in the rocks of the close-in zone. Part 3 is an interpretation of the observations reported in Part 2. (D.H.M.)

56046 (UCRL-Trans-10615(Pt.2)) RESEARCH ON GEOLOGIC EFFECTS OF UNDERGROUND NUCLEAR EXPLOSIONS IN A SAHARA GRANITE MASSIF. Faure, Jean (Nancy Univ. (France). Faculte des Sciences). Translated for Univ. of California Lawrence Livermore Lab., from a French dissertation. 169p. Dep. NTIS.

The results of special methods used to analyze the geologic effects of underground nuclear explosions in granite of Tauorirt Tan Afella, Africa are presented. The study, based on a synthesis of results obtained during each experiment, attempts a numerical analysis of the effects of explosions. Data from television cameras in boreholes, in-situ permeability measurements, and detailed mineral studies in the laboratory are used to support the numerical analysis. The geological effects studied include: mineralogical transformations, cavity and chimney formation, zone-of-fracturing, and surface damage. (L.C.L.)

56047 (UCRL-Trans-10616-1) GASES FORMED IN AN UNDERGROUND NUCLEAR EXPLOSION: CHEMICAL EQUILIBRIA AND POTENTIAL APPLICATIONS. Cohen, P. Translated for Univ. of California Lawrence Livermore Lab., from report IAEA-PL-388/7. 16p. Dep. NTIS.

The results obtained on the composition and quantities of gas produced during underground explosions in Sahara granite are restated and interpreted. Emphasis is placed on the problem involved in such evaluation in the case of an oil shale medium. Several possible applications in the petrochemical industry (fertilizers, etc.) for hydrocarbons originating from nuclear stimulation are proposed and discussed. (auth)

56048 (UCRL-Trans-10617-7) STUDY OF TWO GRANITES. Habib, P. (Ecole Polytechnique, Paris (France)). Translated for Univ. of California Lawrence Livermore Lab., from a French Report. 14p. Dep. NTIS.

Studies were made on the density, velocity of sound propagation, and tensile properties of granites with white felspars originating from drilling cores not showing any fissuring visible to the naked eye and also slightly fissured blocks E_3 north. Data are tabulated. (P.C.H.)

56049 VERTICAL DEFORMATION PRODUCED BY SOME UNDERGROUND NUCLEAR EXPLOSIONS. Bucknam, R. C. (Geological Survey, Denver). Bull. Seismol. Soc. Amer.; 62: No. 4, 961-71(Aug 1972).

Vertical deformation which has been produced by underground nuclear explosions and which includes both the primary effects of the explosion and the secondary effects of triggered faulting was studied by means of data from high-accuracy level-line surveys. The results from several large tests indicate that for a megaton-size explosion the primary effects are expected to produce permanent vertical displacements of less than 2 to 3 cm at distances greater than 2 to 3 km from GZ (ground zero). Larger vertical displacements at more than several kilometers from GZ are commonly associated with movement on pre-existing faults. In areas that are uncomplicated by multiple structural features, the vertical displacements associated with fault movement vary, in a regular manner, to a considerable distance from the fault. The general pattern of fault-related displacements is similar to that predicted by dislocation theories of faulting but is modified by an overall tendency to subsidence. Analysis of vertical displacements in the vicinity of a fault activated by one explosion indicates a depth of faulting of about 1,500 m. Most fractures observed at the surface may be relatively shallow features only indirectly related to the processes which produce the aftershock sequences that follow large explosions. (auth)

56050 CALCULATED COMPRESSIONAL-WAVE ARRIVALS FROM UNDERGROUND NUCLEAR DETONATIONS. Murphy, John R. (Environmental Research Corp., Las Vegas, Nev.). Bull. Seismol. Soc. Amer.; 62: No. 4, 991-1016(Aug 1972).

Analytical expressions have recently been derived by Červený (1965) for the principal waves generated at a plane interface between two elastic solids attributable to a spherical compressional wave arriving at an arbitrary angle of incidence. These results are generalized to incorporate a nuclear seismic source function acting in a multilayered, linearly inelastic half-space. Using a seismic source function appropriate for the nuclear event Boxcar and an approximate crustal model, the particle velocity profiles corresponding to those compressional-wave types which are routinely identified on measured, near-field seismograms are calculated and compared with the observed data for this event. These comparisons indicate that the peak amplitudes of some important compressional-wave types can be predicted with reasonable accuracy using a relatively simple model of the seismic transmission path. (auth)

56051 MULTIPLE INNER CORE REFLECTIONS FROM A NOVAYA ZEMLYA EXPLOSION. Adams, R. D. (Univ. of California, Berkeley). Bull. Seismol. Soc. Amer.; 62: No. 4, 1063-71(Aug 1972).

The phases P2KP, P3KP, and P4KP are well recorded from the Novaya Zemlya nuclear explosion of October 14, 1970, with the branch AB at distances of up to 20° beyond the theoretical end point A. This extension is attributed to diffraction around the core-mantle boundary. A slowness $dT/d\Delta = 4.56 \pm 0.02$ sec/deg is determined for the AB branch of P4KP, in excellent agreement with recent determinations of the slowness of diffracted P. This slowness implies a velocity of 13.29 ± 0.06 km/sec at the base of the mantle, and confirms recent suggestions of a low-velocity channel above the core-mantle boundary. There is evidence that arrivals recorded before the AB branch of P2KP may lie on two branches, with different slownesses. The ratio of amplitudes of successive orders of multiple inner core reflections gives a lower bound of about 2200 for Q in the outer core. (auth)

Protective Structures and Equipment

Refer also to abstracts 56509 and 56757.

56052 (CONF-720823–1) NEW EXHAUST SYSTEM FOR EXISTING FACILITY. Fuller, A. B. (Oak Ridge National Lab., Tenn.). [nd]. 32p. Dep. NTIS.

From twelfth air cleaning conference; Oak Ridge, TN. (28 Aug 1972).

A reliable exhaust system was designed to ventilate gloved enclosures in an existing building which was modified to provide for the safe handling of kilogram quantities of alpha-emitting materials. The new exhaust system was designed especially for this purpose, and as a separate system, it relieved the existing overtaxed exhaust systems which could not be economically upgraded to perform the same function. The arrangement of components and the features incorporated in the new system provide many improvements in reliability and maintenance not found in other systems of this type. The more significant events experienced during the design, fabrication, and installation of this system, beginning with the design criteria and ending with an objective critique for the benefit of others, are discussed. (auth)

56053 INTERLOCKS FOR GENERAL PURPOSE RADIOGRAPHIC ROOMS. Bushong, S. C.; Prasad, N.; Briney, S. (Baylor Univ., Houston, Tex.). Health Phys.; 23: No. 3, 392-4(Sep 1972).

The common practice of neglectful use of protective barriers and doors in diagnostic and therapeutic radiology departments is deplored. A system of interlocks to be installed on all relevant doors in such departments is described such that no x-ray tube could be energized if any door was open or ajar. It is stressed that such precautions are equally as necessary in diagnostic as in therapeutic radiology as data demonstrate that measurably higher exposures were received by diagnostic compared to therapeutic personnel. Initial objections to the installation of interlocks is discussed and the probable cost suggested. (UK)

56054 HEAVY CONCRETE UNITS FROM BLACK SANDS FOR PROTECTION FROM GAMMA RADIATION. Ibrahim, D. M.; Gad, G. M. (National Research Centre, Cairo). Sprechsaal Keram., Glas, Email, Silikate; 103: No. 14, 635-6(1970).

Heavy concrete was produced from zircon and magnetite fractions from the northern coast of the UAR using Pb_3O_4 as binder. The aggregate was formed in pellets and fired at 780°C. The properties of this heavy concrete were determined and compared with those of ordinary concrete. The ^{60}Co-γ-attenuation was measured on cylindrical specimens resulting in good shielding properties. (INIS)

56055 SPECIAL BUILDING MATERIALS FROM BLACK SANDS FOR THE PROTECTION FROM γ RADIATION. Ibrahim, D. M.; Gad, G. M. (National Research Centre, Cairo). Sprechsaal Keram., Glas, Email, Silikate; 103: No. 17, 768-73(1970).

Black sands and their commercially separated constituents: magnetite, ilmenite, zircon and monazite, were studied in an attempt to use in making dense building materials suitable for shielding from radiation. Dense bodies were made from black sand constituents and glass forming additives such as Pb_3O_4 and $BaCO_3$. Clay and talc were also added as binding substances. Physical characteristics of the fired bodies were followed. Gamma attenuation properties of the dense building units were determined. Results indicated their good shielding characteristics. (auth) (INIS)

56056 RELATIVE SHIELDING PROPERTIES OF AMMONIUM METATUNGSTATE FOR NEUTRONS AND GAMMA RAYS FROM ^{252}Cf. Senftle, F. E.; Philbin, P. (Geological Survey, Washington, D. C.). Health Phys.; 23: No. 4, 529-32(Oct 1972).

The hydrogen and tungsten content and the high solubility of ammonium metatungstate suggested that a saturated aqueous solution of this salt would make a good neutron-gamma shield for ^{252}Cf. Comparative attenuation experiments with a saturated aqueous solution and pure water showed that the ammonium metatungstate solution was a significantly better shielding material for gamma rays and slow neutrons, and better than water for fast neutrons. For ^{252}Cf sources of less than 500 μg, a shield consisting of a thick paste of ammonium metatungstate is recommended as a useful shielding material in place of a saturated solution to reduce the hazard in case of container leakage. It is pointed out that a saturated solution of ammonium metatungstate is relatively clear and may be used as an absorber in windows of hot cells. (auth)

56057 MEDICAL AND HEALTH PHYSICS ACTIONS FOLLOWING EMERGENCIES AT NUCLEAR SITES OF THE CEGB. Gregory, J.; Orchard, H. C. (Central Electricity Generating Board, London). J. Inst. Nucl. Eng.; 13: No. 4, 117-20(Jul 1972).

The medical and health physics actions that would follow a serious accident at a nuclear site operated by the Central Electricity Generating Board are described. Both on and off-site activities are covered, together with the emergency procedures for the CEGB Berkeley Nuclear Laboratories, and for accidents involving the transport of irradiated nuclear fuel. (auth)

56058 OPTIMUM SHIELDING CONDITIONS FOR LOW-LEVEL WHOLE-BODY ACTIVITY MEASUREMENTS. Schmier, H. (Federal Health Office, Berlin). pp 147-52 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

A considerable part of the total cost of an installation for measuring low-level radioactive substances is due to the necessary shielding. Ways of reducing the shielding expenses by selecting appropriate construction materials when designing new installations are described. Good shielding efficiency can be achieved by combining an inexpensive material of low atomic number (e.g., sand) with a material of high atomic number (e.g., lead). These materials should have low intrinsic activities. (auth)

56059 INVESTIGATIONS INTO MODERATE-COST SHIELDING IMPROVEMENTS TO A STANDARD STEEL ROOM USING AN APPROXIMATE SCALE MODEL. Erlenbach, H. R. (Gewerbeaufsicht des Landes Nordrhein-Westfalen, Duesseldorf). pp 153-60 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Some improvements are described that could be made at moderate cost to a standard steel room made of 15 cm-thick pre-atomic-age naval steel plates and a 0.3 cm-thick lining of lead which should be as old as possible. These improvements are especially feasible if the environmental conditions of the steel room to be erected are still to be determined or are to be altered. The feasibility of the following measures was studied: the construction of the walls surrounding the steel room from components selected for their low activity; embedding the steel room in sand layers of optimum thickness and of least possible activity; and optimal thickening of the lead lining inside the steel room with low-activity lead. These studies were preceded by an assessment of the intrinsic radioactivity in potential building or shielding materials of different origin. An account is given of all the measurements performed, and the results obtained are reported. (auth)

56060 EXPERIMENTAL DETERMINATION OF THE COEFFICIENT OF TRANSPORT OF RADIOACTIVE SUBSTANCES FROM CONTAMINATED SURFACES INTO THE AIR OF WORKING AREAS. Gorodinskii, S. M.; Gol'dshtein, D. S.; Margulis, J. Ya.; (and others). Gig. Sanit.; No. 5, 46-50(May 1972). (In Russian).

Results are reported for an experimental determination under laboratory conditions of the coefficient of transport of radioactive substances into the air from the surface of various materials, such as carbonic steel (with and without paint coating), stainless steel, vinyl plastics, and organic glass. The relation between the coefficient of transport (coefficient of blowing off) and such factors as temperature, humidity, and current rate of air was studied. (auth)

Safety Engineering

Refer also to abstracts 55993 and 56782.

Vacuum Engineering

Refer also to abstract 56769.

56061 SURFACE STRUCTURE: AN EMERGING SPECTROSCOPY. Duke, C. B. (Xerox Research Labs., Rochester, N. Y.); Park, Robert L. Phys. Today; 25: No. 8, 23-8; 30(Aug 1972).

Discussions of recent developments in the study of surface phenomena and their relations with advances in vacuum technology are presented. Current vacuum techniques used in studies of surfaces are described. Information is included on surface geometry, electronic structure, and atomic motion. (J.R.D.)

56062 PUMPING BY CHEMICAL MEANS. Tom, Theodore (Veeco Instruments Inc., Sunnyvale, Calif.). Phys. Today; 25: No. 8, 32-9(Aug 1972).

The processes involved in sputter-ion and sublimation vacuum pumps are described. The basis for the sputter-ion pump, the Penning discharge, is discussed along with sublimation pumps based on a generated reactive metal film such as Ti heated to its sublimation temperature. (J.R.D.)

56063 GAUGES FOR ULTRAHIGH VACUUM. Lange, W. J. (Westinghouse Research and Development Center, Pittsburgh). Phys. Today; 25: No. 8, 40-3; 46-50(Aug 1972).

Vacuum gages such as the Bayard—Alpert total-pressure gage improved hot-cathode gages, and magnetic field gages are described. Brief discussions are also included on partial pressure gages with which the residual gases may be identified or measured separately. (J.R.D.)

56064 SELECTING MATERIALS AND HARDWARE. Wheeler, William R. (Varian Associates, Palo Alto, Calif.). Phys. Today; 25: No. 8, 52-8(Aug 1972).

Aspects of contamination and purification as related to vacuum system performance are described. Requirements for vacuum system components such as joints, valves, and feedthroughs are reviewed. Information is included on gas-surface interactions, surface cleaning, valve varieties, and gasket materials. (J.R.D.)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 55767, 56072, 56083, 56141, 56197, and 58022.

56065 (CONF-720627–, pp 1.1-18) AUSTRALIA'S ENERGY REQUIREMENTS UNTIL THE YEAR 2000. Hayes, J. E. (State Electricity Commission of Victoria, Melbourne).

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

Forecasts for primary energy consumption in Australia were examined by consideration of areas of uncertainty and by comparison with forecasts for the U.S.A. Forecasts were made for maximum, minimum, and "most probable" electrical energy demand, taking into account judgement of the effect of indicated future local and global energy supply and demand situations on the economic incentive to install nuclear power. Two predictions of electricity consumption to 2000 AD are presented. One is based on socio-economic factors using forecasts for each major determinant of demand such as real G.N.P., and the other is based on an 8.3% average trend growth rate for the period 1965 to 1971. It is considered that a greater dependence on non-depletable energy resources after 2000 AD can be anticipated if only for environmental reasons. Exhaustion of fossil fuel resources will increase this dependence and nuclear power generation would appear the only commercially feasible alternative conditional on continued safe operation. The first Australian nuclear power stations may be brought into service in the period 1985 to 1990. (Australia)

56066 (CONF-720627–, pp 2.1-12) ECONOMIC REVIEW OF AUSTRALIA'S ENERGY RESOURCES. Gleeson, L. T.

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

Australian surface and underground energy resources are reviewed. Wood contributes 2%, bagasse 1.5%, and hydro 1.5% of energy needs. Black coal is still the biggest energy resource; production in 1970/71 was 50 million tons; brown coal production has been about 23 million tons p.a.; natural gas is expected to achieve 10% of energy requirements by 1980. Present oil reserves are expected to satisfy 30% of local needs by 1980. Total estimated U_3O_8 to the end of the century is 70,000 short tons. It is suggested that in the late 1980's fuel use for electricity production will be in the order black coal, brown coal, natural gas, oil, hydro, and nuclear. It is thought that nuclear power need not be an important factor in Australia's economic development this century because apart from oil, self-sufficiency in resources will be maintained; by world standards fossil energy is likely to be cheap; and fossil fuels have a low sulfur content and do not have as large an impact on the environment as those of other countries. (Australia)

56067 (CONF-720627–, pp 3.1-9) NEED FOR A NATIONAL ENERGY POLICY INCLUDING EXPORT. Stewart, F. E.

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

Some aspects of and questions raised by a national energy policy for Australia are discussed. Assessing fossil and uranium resources and planning the coordination of their utilization are thought to be best achieved with the aid of a national energy authority. (Australia)

56068 (GJO–4168-1) PRECAMBRIAN THROUGH CRETACEOUS STRATA OF PROBABLE FLUVIAL ORIGIN IN SOUTHEASTERN UNITED STATES AND THEIR POTENTIAL AS URANIUM HOST ROCKS. Dennison, John M.; Wheeler, Walter H. (North Carolina Univ., Chapel Hill (USA). Dept. of Geology). 1 Feb 1972. Contract AT(30-1)-4168. 211p. Dep. NTIS.

Information is presented in an effort to provide a basis for evaluating the fluvial sandstones of the southeastern United States as a possible source of uranium. Maps are presented showing the outcrop pattern of 25 stratigraphic units, with thickness and other information. A summary description is given of the stratigraphic occurrence, petrography, provenance, and sedimentary structures including indication of current vectors. Factors affecting ground water circulation, past or present, are evaluated in an effort to locate conditions favorable for uranium ore development. Redbeds may serve as indicators of oxidizing facies and are therefore important. The boundary between oxidizing (red or drab) and reduzate (gray, greenish, or black coloration) facies is delimited where possible. One aim is to locate the counties in which each stratigraphic unit appears to be most favorable for uranium on the basis of host rock characteristics. This should facilitate field examination of the rocks for more specific indications of uranium deposits. (auth)

56069 (ORO–3852-7) GEOCHEMICAL BEHAVIOR OF URANIUM AND THORIUM SERIES NUCLIDES. Annual Progress Report, 1971–72. Sackett, William M. (Texas Agricultural and Mechanical Univ., College Station. Dept. of Oceanography). 1972. Contract AT(40-1)-3852. 82p. Dep. NTIS.

Developments are reported for studies on: removal of Th from seawater and contemporary geochemistry of uranium. Previous studies on Th in seawater are reviewed, particularly in regard to depth. A new geochemical balance for U in the Gulf of Mexico (GOM) is in the process of the final stages of computation. Input from over 22 rivers entering the GOM was analyzed. The results indicated that the GOM receives some of the highest U input concentration of any known basin. (P.C.H.)

56070 CALEDONIAN GEOLOGY AND URANIUM-BEARING STRATA IN THE TAASJOE LAKE AREA, SWEDEN. Armands, Goesta (Univ. of Stockholm). Geol. Foren. Stockholm Forh.; 94: No. 549, 321-45(24 Jun 1972).

Uranium indications in the Taasjoe Lake area, Sweden mainly the basal Ordovician units have been studied. Electromagnetic, magnetic, and radiometric aerial prospecting has been carried out over the entire concession area, with a line spacing of 125 m at an altitude of 30 m. By means of field studies, including 68 boreholes comprising in all 2131 m of core, geological, tectonic, radiometric, and geochemical ground studies and investigations of the aerial anomalies, it has been possible to map the extension of the uranium-bearing unit within an area 20 to 30 km long and 10 km wide. Palaeontological studies in the area have shown that the uranium-bearing units is Early Ordovician in age. The structural geology of the area is characterized by short overthrusts of the Schuppen type, although gentle folding is also found. Electromagnetic anomalies have been of critical importance in interpreting large-scale tectonic features. The study shows that the "Varegian" quartzite interpreted previously as an Uppermost Precambrian autochthon should be classified as Lower Cambrian. The investigations also indicate that the Vemdal quartzite, which had previously been thought to form nappes, is part of the autochthon. These quartzites are best classified as para-autochthonous. Drilling through the "graywacke nappe of the Foellings – Holmsjoe facies" shows clearly that this graywacke is autochthonous. A generalized geological map of the concession area has been produced. The larger structural features of the sedimentary rocks in the border zone to the Caledonides are discussed from the viewpoint of the miogeosyncline's character. Several attempts have been made to enrich and leach the uranium and phosphorous of the Lycophoria shale. However, no method which would be suitable both technically and economically has been found. (auth) (Sweden)

56071 COMMENTS ON "A URANIUM-BEARING LAYER FROM THE LOWER ORDOVICIAN, SWEDEN." Gee, David G. (Sveriges Geologiska Undersoekning, Stockholm). Geol. Foren. Stockholm Forh.; 94: No. 549, 369-73(24 Jun 1972).

Aspects of Goesta Armands's paper "A uranium-bearing layer from the Lower Ordovician, Sweden" are discussed. The stratigraphical context of the Taasjoe uraniferous unit is reviewed and a tentative model for its depositional environment is proposed. (auth) (Sweden)

Radioactive Effluents

Refer also to abstracts 55967, 55996, 56572, 56776, 58203, 58288, and 58409.

56072 (CONF-720627) SYMPOSIUM PAPERS ON THE ROLE OF NUCLEAR ENERGY IN AUSTRALIA'S DEVELOPMENT, CANBERRA, JUNE 1st AND 2nd, 1972. (**Australian Academy of Science, Canberra. Society for Social Responsibility in Science (Australia). Australian Atomic Energy Commission**). 28 Jun 1972. 282p.

Twelve articles are included; a separate abstract was prepared for each. The Symposium dinner address and a critique on social implications are also included. (P.C.H.)

For abstracts of individual papers see: 56065–56067, 56073, 56074, 56285, 56772, 56776, 57827, 58012, 58013, and 58337.

56073 (CONF-720627–, pp 7.1-20) ENVIRONMENTAL HAZARDS OF FOSSIL AND NUCLEAR POWER PRODUCTION. Watson, G. M. (**Australian Atomic Energy Commission, Sydney**). (AAEC/TM–627).

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

The public health costs of nuclear power are discussed on the basis of authorized routine discharges of radioactivity to the environment without consideration of accidents. The discussion begins from the standpoint that there is a rapidly growing demand for electric power and the best way of meeting it should be sought. Environmental hazards include effects on human health, on the living things of the environment, and on the inanimate environment, such as air, waters, soils, and rocks that support life and possess varying degrees of intrinsic appeal to man. (P.C.H.)

56074 (CONF-720627–, pp 8.1-35) RADIOACTIVE WASTES IN THE URANIUM MINING INDUSTRY. **Melouney, H. F. (Mary Kathleen Uranium Ltd., Melbourne).**

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

Radioactive and chemical waste handling in the uranium mining and milling industry is discussed with particular reference to health hazards, standards, and the Australian experience at Rum Jungle, Radium Hill, and Mary Kathleen as well as experience in Canada and the U.S.A. An outline is given of environmental impact regulations and their development in the U.S.A. and these are related to the Australian situation. (Australia)

56075 PLUME RISE DETERMINATION: A NEW TECHNIQUE WITHOUT EQUATIONS. Moses, Harry; Kraimer, Martin R. (Argonne National Lab., Ill.). J. Air Pollut. Contr. Ass.; 22: No. 8, 621-30(Aug 1972).

A new equationless technique for estimating plume rise as well as a comparison of seventeen commonly used plume rise formulas is presented. Data from 10 sets of experiments, involving 615 observations and 26 different stacks, were used to study the relation between plume rise and related meteorological and stack parameters. An independent data set was used to test the derived methods for determining plume rise. These data were obtained by Bringfelt of Sweden and contained measurements from stacks smaller than that at the Argonne National Laboratory to those approaching the TVA stacks. A significant improvement in the prediction of plume rise from meteorological and stack parameters resulted from the use of a new technique called the Tabulation Prediction Technique. This is a method whereby an estimate of the value of a dependent variable may be obtained from information on the independent variables. Combinations of the independent variables—wind speed, heat emission rate, momentum rate, and stability—are arranged in an ordered sequence. For each combination of independent variables, the cumulative percentile frequency distribution of the dependent variable based on past measurements is given along with other statistics such as the mean, standard deviation, and interquartile range, i.e., the difference in plume rise between the 75th and 25th percentile values. Thus, one may look up the combination of independent variables just as one looks up words in a dictionary to obtain the percentile frequency distribution of the dependent variable. The mean, for each combination of independent variables, may be considered as the best estimate for the given conditions. (auth)

56076 NUCLEAR POWER PLANTS AND THE ENVIRONMENT. Guilhamon, Jean (Electricite de France, Paris). Rev. Fr. Elec.; 45: No. 236, 8-13(1972). (In French).

The design and operational features of nuclear power plants are such that they add very little radioactivity to the surrounding environment. The means adopted to avoid the contamination of personnel with radiations emitted by the core are briefly reviewed as well as problems arising from external contamination due to the inhaling or ingestion of products dispersed outside the reactor. (France)

56077 POLLUTION SOURCES IN NUCLEAR POWER GENERATION. **Purica, I. I. (Inst. of Atomic Physics, Bucharest). Progr. Stiintei; 8: No. 2, 166-8(Apr 1972). (In Rumanian).**

The effects of pollution, defined as "a negative reaction of the system used to fulfill the needs of mankind," are examined on the basis of global energy requirements. It is pointed out that fission-based nuclear energy will exhaust soon the uranium-rich ores and the use of low-grade granites must be considered; their treatment will result in considerable amounts of waste materials. By the year 2000 about 500 tons/day of uranium must be burned. It is expected that fusion will be the basis of power generation in about 20 years. The main contamination problems of nuclear power plants are caused by the release of waste heat and radioactive materials. Pollution problems cannot be handled locally; they require international cooperation. It is proposed that the International Atomic Energy Agency be placed in charge of such cooperative efforts. (TTT)

56078 PRODUCTION OF RADIOACTIVE WASTE WATERS IN CZECHOSLOVAKIA. **Pazdernik, J. (Water Research Inst., Prague). Vod. Hospod., B.; 21: No. 5, 132-4(1971). (In Czech).**

A review is presented on waste waters from individual types of nuclear installations in Czechoslovakia. The waste waters discharged by radioactive ore mining and processing plants constitute the gravest problem; nuclear reactors and auxiliary installations are, or will be, another source. However, the maximum permissible concentration of radioactive substances has not so far been exceeded. Long-lived isotopes of the uranium-radium series are the basic radioactive component of waste waters resulting from radioactive ore mining and processing. Waste waters from reactor operation contain not only long-lived highly toxic substances but also a broad scope of medium-lived nuclides. The amount of waste waters resulting from uranium ore mining and processing exceeds, by three to four orders of magnitude, the amount of waste waters resulting from reactor operation. (NSA of Czech.)

Radioactivity Transport and Monitoring

Refer also to abstracts 56074, 56076, 56165, 56355, 56502, 56504, 56510, 56564, 56572, 56573, and 56772.

56079 (BNWL-SA–4362) SAMPLING FOR RADIONUCLIDES AND OTHER TRACE SUBSTANCES. **Eberhardt, L. L. (Battelle Pacific Northwest Labs., Richland, Wash.). [nd]. Contract** AT(45-1)-1830. 24p. (CONF-720715–1). Dep. NTIS.

From Advanced Institute on Statistical Ecology conference; University Park, PA. (15 Jul 1972).

Sampling objectives and available technology are discussed along with background and nature of problems, and components of a study of environmental contamination. A list of some environmental problems and categories of environmental problems are also given. (P.C.H.)

56080 (CONF-701067–, Paper 16) AIR POLLUTION PROBLEMS IN NUCLEAR POWER DEVELOPMENT. Radford, Edward P. (Johns Hopkins Univ., Baltimore, Md.). 1970. 11p.

From Air pollution medical research conference; New Orleans, LA. (5 Oct 1970).

Many phases of nuclear power development are being achieved with relatively little environmental contamination with hazardous radionuclides, and in these instances the promise of a pollution-free power source can nearly be achieved. However, there are two principal sources of air pollutants from nuclear power operations. At plant site, boiling water reactors release airborne noble gases, chiefly xenon isotopes, while at nuclear fuel reprocessing plants, release of gaseous krypton-85 and tritiated water vapor are potentially important air pollution problems. At present, the nuclear power industry is the only major industry whose operations will inevitably lead to the distribution of mutagenic material to the general population, and for this reason close regulation of the industry is mandatory. (auth)

56081 (HASL–266) INDEX OF INTERPRETIVE ARTICLES PUBLISHED IN THE HEALTH AND SAFETY LABORATORY FALLOUT PROGRAM QUARTERLY SUMMARY REPORTS: FROM 1958 THROUGH APRIL 1972. **Volchok, Herbert L. (ed.) (Health and Safety Lab. (AEC), New York). 1 Oct 1972. 69p. Dep. NTIS.**

The index is printed in chronological order starting with HASL-42, Oct. 1958 and ending with HASL-249, April 1, 1972. Separate author and subject indexes are also included. (P.C.H.)

56082 (KFK–1608) MAXIMUM OF EXPECTED RADIATION DOSE ON THE ENVIRONS OF THE KARLSRUHE NUCLEAR RESEARCH CENTER IN THE YEAR 1972. Huebschmann, W.; Papadopoulos, D. (Kernforschungszentrum, Karlsruhe (West Germany)). May 1972. 17p. (In German). Dep. NTIS (U. S. Sales Only).

The radiation doses at the Karlsruhe Nuclear Research Center and in its environment resulting from the expected radioactive emissions into the atmosphere are calculated annually. The emissions from sources in the area of the research center are listed. As in the previous year, the main contributions were made by the WAK reprocessing plant and the FR 2 research reactor. The expected emission by WAK of ^{85}Kr and ^{131}I was reduced, resulting in slightly lower β- and very much lower iodine doses. The improved methods of calculation now include the real geometrical distribution of the various emitters. In all the surrounding villages, the expected radiation doses remain far below the permissible limits. This is true even if the recent more restrictive guidelines for nuclear plants are applied. (auth)

56083 (RME–4114) RADON EMANOMETRY OF STARKS SALT DOME, CALCASIEU PARISH, LOUISIANA. Gabelman, John W. (Division of Production and Materials Management (AEC), Washington, D. C.). Mar 1972. 75p. GPO $0.70.

Starks dome was surveyed in 1970 to detect subsurface radon emanations. The salt plug cap, about 3,700 ft in dia and 1,200 ft deep, is penetrated by hundreds of drill holes through which sulfur and salt have been produced. Oil is derived from small Miocene sand lenses over and alongside the plug at depths of 1,000 to 4,000 ft. Alpha counts were made on soil gas pumped from the bottom of freshly drilled 3-ft holes. Gamma counts were obtained from hole bottoms and the surface. Northeast and northwest traverses across the dome illustrate weak anomalies around the periphery and locally in the interior. The difference in alpha and gamma profiles suggests radon derived from radium at depth rather than from soil. The peripheral anomaly may be controlled by marginal ring faults and the interior anomalies by radial faults; such structures offer convenient and efficient migration channels. No anomalies are directly associated with drill holes, which thus do not serve as channels, perhaps because of casing. The salt plug brine and cap sulfur are not radioactive. Uranium and more abundant thorium identified in petroleum are the probable radon sources. Thorium and uranium are most plentiful in the crude petroleum fraction, less in brine separated from oil, and least in the solid mineral residue that nevertheless contains the most daughter products. Petroleum is well known to scavenge uranium but has less effect on thorium because of the latter's lower surficial mobility. Variations in emanation exceeding the range of anomality were noted in base-station measurements, governed by temperature, pressure, and water content of the soil. A program to measure and evaluate these variations is in progress to establish corrections for future surveys. (auth)

56084 (SCPRI(RM)–1-1972 and Suppl.) REPORT OF ACTIVITY, JANUARY 1972. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 35p. (In French). Dep. NTIS (U. S. Sales Only).

Radiation protection activities during January 1972 are summarized. These include interpretation of the main results of environmental surveys, the statement of control and assistance operations in a work environment, and a bibliographical selection. Detailed tables of the measurement results are given. (P.C.H.)

56085 (SCPRI(RM)–2-1972 and Suppl.) REPORT OF ACTIVITY, FEBRUARY 1972. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 33p. (In French). Dep. NTIS (U. S. Sales Only).

Radiation protection activities during February 1972 are summarized. These include interpretation of the main results of environmental surveys, the statement of control and assistance operations in a work environment, and a bibliographical selection. Detailed tables of the measurement results are given. (P.C.H.)

56086 (SCPRI(RM)–3-1972 and Suppl.) REPORT OF ACTIVITY, MARCH 1972. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 38p. (In French). Dep. NTIS (U. S. Sales Only).

Radiation protection activities during March 1972 are summarized. These include interpretation of the main results of environmental surveys, the statement of control and assistance operations in a work environment, and a bibliographic selection. Detailed tables of the measurement results are given. (P.C.H.)

56087 (SCPRI(RM)–4-1972 and Suppl.) REPORT OF ACTIVITIES, APRIL 1972. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 30p. (In French). Dep. NTIS (U. S. Sales Only).

Radiation protection activities during April 1972 are summarized. These include interpretation of the main results of environmental surveys, the statement of control and assistance operations in a work environment, and a bibliographic selection. Detailed tables of the measurement results are given. (P.C.H.)

56088 (SCPRI(RM)–5-1972 and Suppl.) REPORT OF ACTIVITIES, MAY 1972. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 1972. 39p. (In French). Dep. NTIS (U. S. Sales Only).

Radiation protection activities during May 1972 are summarized. These include interpretation of the main results of environmental surveys; the statement of control and assistance operations in a work environment, and a bibliographical selection. Detailed tables of the measurement results are given. (P.C.H.)

56089 (SCPRI(RM)–6-1972 and Suppl.) REPORT OF ACTIVITY, JUNE 1972. ANNEX TO MONTHLY REPORT, DETAILS OF RESULTS OF MEASUREMENT, JUNE 1972. (Service Central de Protection Contre Les Rayonnements Ionisants, le Vesinet (France)). Jun 1972. 48p. (In French). Dep. NTIS (U. S. Sales Only).

A summary of the results of the environmental survey for June 1972 is presented. The results are presented in the form of environmental surveys, the statement of control and assistance operations in a work environment, and a monthly bibliographic selection. The materials monitored include atmosphere, rainwater, ground and surface waters, drinking water, milk, vegetables, bovine thyroids, fish, seawater, animal bones, and soils. (P.C.H.)

56090 (SCPRI(RM)–12-1971 and Suppl.) REPORT OF ACTIVITIES, DECEMBER 1971. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 38p. (In French). Dep. NTIS (U. S. Sales Only).

Radiation protection activities during December 1971 are summarized. These include interpretation of the main results of environmental surveys, the statement of control and assistance operations in a work environment, and a bibliographical selection. Detailed tables of the measurement results are given. (P.C.H.)

56091 (SWRHL–108-r) OFF-SITE SURVEILLANCE ACTIVITIES OF THE SOUTHWESTERN RADIOLOGICAL HEALTH LABORATORY FROM JANUARY—JUNE 1970. (Western Environmental Research Lab., Las Vegas, Nev.). Aug 1972. 68p. Dep. NTIS.

During the period January through June 1970, 24 announced underground nuclear tests were conducted by the U. S. Atomic Energy Commission at its Nevada Test Site. The Western Environmental Research Laboratory conducted an off-site surveillance program during this period. The Snubber Event, conducted on April 21, 1970, accidentally released detectable radioactivity to the off-site area. The maximum exposure rate observed on portable survey instruments was 0.6 mR/h at Coyote Summit on Highway 25 during cloud passage. The integrated net gamma exposure at this location was 0.15 mR. The maximum time-integrated concentration of airborne radioactivity was found on filters from a portable air sampler operating at the same location. These were 1.9 μCi · sec/m^3 ^{133}I and 6.6 μCi · sec/m^3 ^{135}I. No water or milk samples collected from sources used for human consumption were found to contain fresh fission products. On May 6, 1970, the entry tunnel for the Mint Leaf Event was ventilated to enable technicians to reenter the area. A portable air sampler operating at the time on Highway 25 at the Valley Road Junction (near Koyne's Mill) collected 700 pCi/m^3 ^{135}Xe on a charcoal cartridge, assuming 100% collection efficiency. The collection efficiency of activated charcoal for xenon was uncertain, but past experience would indicate approximately 10 to 15%. Therefore, the actual concentration could have been seven to ten times that reported. No dosimetry devices collected during this six-month period showed exposures above normal background fluctuations. All off-site exposures were well below the standards and guides established for off-site radiological safety. (auth)

56092 (TID–26164) BIOENVIRONMENTAL EFFECTS ASSOCIATED WITH NUCLEAR POWER PLANTS: A SELECTED BIBLIOGRAPHY. Mayer, Ramona A.; Rudolph, Ann W.; Bell, Duane E.; Davidson, Richard S. (comps.) (Battelle Columbus Labs., Ohio). 30 Jun 1972. Contract W-7405-eng-92. 292p. Dep. NTIS.

References (466) are given to reports, journals, books, and conferences published from approximately 1962 to Jan. 1972. Sources used for selection of references were NSA, special bibliographies, and review papers. Separate keyword, author, and report number indexes are included. (P.C.H.)

56093 DATA. SECTION IV. OTHER DATA. Radiat. Data Rep.; 13: No. 7, 417-23(Jul 1972).

The results of environmental monitoring during Jan. through June 1968 at off-site areas near the Nevada Test Site are presented. Tabulated data are given for: gross beta and gross gamma radioactivity in ground-level atmosphere; ^{140}Ba, ^{131}I, ^{133}I, ^{132}Te, and ^{187}W content of ground-level atmosphere; and the ^{131}I and ^{133}I content of area milk samples. The July through Dec. 1968 radiation monitoring activities at Brookhaven National Laboratory are described. Measurements of the gamma radioactivity levels at the BNL site perimeter are tabulated. The gross beta radioactivity and H_3 content measured in liquid wastes at the BNL site boundary during July through Dec. 1968 are presented. (L.C.L.)

56094 CONDUCTING COMPLEX RADIOECOLOGICAL INVESTIGATIONS IN BIOGEOCENOSES WITH A HIGH RADIOACTIVE BACKGROUND. Maslov, V. I. pp 9-21 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

A biogeoclimatic description is given of regions and individual biogeocenoses (stationary sites) with a high content of natural radioactive elements and, accordingly, a high radiation level, where investigations are carried out by the staff of the radiobiological department of the Komi Branch of the Academy of Sciences, USSR. A brief characteristic is given of the main trends of the research work conducted by individual scientific workers under the program of complex radiobiological investigations. (auth)

56095 HANDLING OF ^{133}Xe IN CLINICAL STUDIES. Rummerfield, P. S. (Univ. of California, La Jolla, San Diego). Phys. Med. Biol.; 17: No. 1, 99(Jan 1972).

It is suggested in a brief note that it is practical to monitor for the presence of ^{133}Xe by drawing possibly contaminated air of known volume into a syringe containing a known volume of air. After agitating, the water could be transferred to a sealed test tube and counted for a "yes" or "no" in a well counter. This suggestion is based on the solubility value of ^{133}Xe gas being 24.1 g/100 cm^3 of water (Handbook of Chemistry and Physics, The Chemical Rubber Co., 1964 to 1965). (UK)

Atmosphere

Refer also to abstract 57876.

56096 (IRI–133-71-18) REPORT OF VISITS FOR CONFERENCES BOTH AT INSTITUTIONS IN THE FIELD OF ENVIRONMENTAL HYGIENE AND OF ACTIVATION ANALYSIS, USA, AUGUST 22–SEPTEMBER 9, 1971. de Goeij, J. J. M. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 26p. (In Dutch). Dep. NTIS (U. S. Sales Only).

The American Nuclear Society Topical Meeting on Nuclear Methods in Environmental Research and the Gordon Research Conference on Environmental Sciences: Air were attended. The American Nuclear Society Meeting concentrated on the subjects of air pollution, water pollution, biomilieu studies, and mercury contamination. The Gordon Research Conference was concerned with origin and disappearance of atmospheric matter, metals and pesticides in the atmosphere, and various gaseous constituents of the air. Visits were made to Oak Ridge National Laboratory, the University of Maryland, the National Bureau of Standards, Internal Revenue Service, and the Naval Research Laboratory. A bibliography of the research mentioned is appended. (J.S.R.)

56097 (NIRS-RSD–34) RADIOACTIVITY SURVEY DATA IN JAPAN. Number 34. (National Inst. of Radiological Sciences, Chiba (Japan)). Feb 1972. 25p. Dep. NTIS (U. S. Sales Only).

Data are reported on the results of surveys on external exposure due to natural radiation, tritium level of river systems and coastal waters in Japan, ^{90}Sr in human deciduous teeth, gross β radioactivity in upper atmosphere; gross β radioactivity in rain and dry fallout; and gross β radioactivity in rain and airborne dust. (P.C.H.)

56098 (UUIM–24) METEOROLOGICAL INFLUENCES UPON THE ARTIFICIAL β-ACTIVITY OF THE ATMOSPHERE. Israelsson, S.; Knudsen, E.; Ungethuem, E.; Enger, L. (Uppsala Univ. (Sweden). Inst. of Meteorology). 1971. 23p. Dep. NTIS (U. S. Sales Only).

Since 1960 the atmospheric radioactivity and the atmospheric-electric elements in the low layer have been recorded at Marsta Observatory (59.9°N, 17.6°E Gr). The variation of the radioactivity is of great importance in the study of atmospheric–electrical phenomena near the ground. In this investigation the variation of artificial β-activity has been studied under different meteorological conditions. The instrument used is an air monitor, which collects suspensions of the air on a moving filter-band. The β-activity of these suspensions is then recorded by means of two scintillation detectors; 78 minutes and 50 hours after the end of the collection. The measuring method made it possible to record relatively rapid oscillations in the activity variations. The sampling time was 3.8 hours. (auth) (Sweden)

56099 (UUIM–25) NATURAL β-ACTIVITY IN THE AIR NEAR THE GROUND. PART A. ON THE DIURNAL VARIATION OF THE NATURAL β-ACTIVITY IN THE AIR NEAR THE GROUND. Hedenmalm, L.; Israelsson, S.; Ungethuem, E. (Uppsala Univ. (Sweden). Inst. of Meteorology). 1971. 24p. Dep. NTIS (U. S. Sales Only).

Since 1960 the β-activity of the air in the low layers has been recorded at Marsta Observatory (59°55′N, 17°35′E Gr). The present investigation has mainly been devoted to a study of the structure of the variation of the natural β-activity and its relationship to the meteorological parameters temperature and wind speed. The natural β-activity shows for different parts of the year a diurnal variation with a maximum at the night and a minimum in the afternoon. In the winter, small amplitudes were obtained because of the small differences in turbulent transfer at night and during daytime due to the low insolation. In summer, however, the amplitudes are greater because of the high insolation. The effects of the insolation upon the diurnal variation of the turbulent transfer seem to be the dominant factor in an explanation of the diurnal variation of the natural β-activity. Good agreement between a theoretically calculated diurnal variation and the actually observed activity variation should be expected. For that purpose a constant rate of exhalation and a sinusoidal diurnal variation of the turbulent transfer was assumed. At least in summer a theoretically calculated diurnal variation of the natural β-activity and an actually observed activity variation seem qualitatively to agree. (auth) (Sweden)

56100 (UUIM–28) RADON AND THORON IN THE AIR NEAR THE GROUND. Israelsson, S.; Knudsen, E.; Ungethuem, E. (Uppsala Univ. (Sweden). Inst. of Meteorology). 1972. 33p. Dep. NTIS (U. S. Sales Only).

The variation of natural radioactivity in the atmosphere is dependent on the exhalation rate from ground surface and the vertical transfer from ground level to upper levels. A decrease of radon (^{222}Rn) and thoron (^{220}Rn) content during passages of rainfalls was noted. The activity changes were, however, fairly small, about 5 to 15%. These activity changes were most pronounced for thoron and for the greatest rainfall intensities. The changes of the radioactivity during the passages of rainfalls may be caused by a decrease in the exhalation rate from the ground surface, but the influence of wind speed also has to be taken into consideration. The wind generally increased somewhat during the passages of the rainfalls and with increasing rainfall intensities. Moreover the rainfalls often occur in connection with front passages, and the changes of air masses may, of course, be of importance owing to the half-life of radon (3.8 days). (auth) (Sweden)

56101 ATMOSPHERIC TRANSPORT AND DISPERSION OVER CITIES. Gifford, F. A. Jr. (National Oceanic and Atmospheric Administration, Oak Ridge, Tenn.). Nucl. Safety; 13: No. 5, 391-402(1972).

In cities, atmospheric dispersion and transport of pollutants are affected by several factors that are not present in the non-urban environment, principally the enhanced surface roughness and heat capacity. The effects of these on the micrometeorology of urban atmospheric boundary layer are briefly summarized, and diffusion models for urban sources are reviewed. The boundary layer over a city is usually nearly adiabatic. Dispersion is enhanced by the increased urban roughness, although transport by the mean wind is slightly decreased by the aerodynamic drag. Such removal processes as fallout and precipitation scavenging, as well as chemical reactions, are briefly discussed. (auth)

56102 RADIOACTIVITY IN THE AIR DURING 1962–64 AND IN FALLOUT DURING 1964–67 IN ROSTOCK. Schulze, H.-A.; Randow, F.; Mehnert, W.; Didrich, L. C. (Univ., Rostock, Ger.). Z. Gesam. Hyg. Ihre Grenzgeb.; 15: 665-9(Sep 1969). (In German).

The radioactivity of the air recorded during the period from 1962 to 1964 and the fallout radioactivity during the period from 1964 to 1967 were measured in Rostock. Maximum values in the air were found in autumn 1963, namely 0.05 (pCi/m^3) for ^{90}Sr and 0.1 (pCi/m^3) for ^{137}Cs. The fallout radioactivity increased in 1967, as compared to 1966 = 100% in the total β-activity (1966 = 17.47 [nCi/m^2]) by 19%, of the ^{90}Sr-activity (1966 = 2.51 [nCi/m^2]) by 70%, and the ^{137}Cs-activity (1966 = 3.65 [nCi/m^2]) by 63%. The activity process was clearly influenced by the Chinese atom weapon tests. (auth)

56103 DATA. SECTION III. AIR AND DEPOSITION. Radiat. Data Rep.; 13: No. 7, 406-16(Jul 1972).

Tabulated data on the gross beta radioactivity measured during March 1972 in surface air and precipitation at 70 U. S. sites, 24 Canadian sites, 12 South American sites, and 24 sites in California are presented. The measured ^{238}Pu and ^{239}Pu contents of dusts at 11 U. S. cities are also tabulated. (L.C.L.)

56104 EVALUATION OF THE TOTAL IONIZATION IN THE LOWER ATMOSPHERE. Ikebe, Yukimasa (Nagoya Univ., Japan). J. Earth Sci., Nagoya Univ.; 18: 85-121(Dec 1970).

To evaluate the total ionization in the lower atmosphere, the ionization due to the following five components of radiations was studied; α-particles from ^{222}Rn (radon) and its daughter products; α-particles from ^{220}Rn (thoron) and its daughter products; β-particles from the ground surface; γ-rays from the ground; and cosmic rays. The ionization due to ^{222}Rn, ^{220}Rn, and their daughter products, denoted by q_{Rn} and q_{Tn}, were estimated from the concentrations of ^{222}Rn and ^{220}Rn in the atmosphere near the ground, respectively. The ionization due to the terrestrial β-, and γ-radiations, and cosmic-rays, denoted by q_β, q_γ, and q_{cr}, was measured with three types of ionization chambers. Although the total ionization of the air near the ground, q_{Total}, amounted to 13 to 14 J in 1964 and 1965, recently it amounted to about 10 J at 1 meter above the ground on the campus of the university. Typical vertical profiles of q_{Rn}, q_{Tn}, q_β, q_γ, q_{cr}, and q_{Total} were evaluated. While q_{Tn} and q_β contribute to q_{Total} mainly below 10 cm height, q_{Rn}, q_γ, and q_{cr} contribute mainly above 1 m height. (auth) (Japan)

56105 SIZE DISTRIBUTION OF RADIOACTIVE AEROSOLS IN AIR NEAR GROUND LEVEL. Ogorodnikov, B. I.; Skotnikova, O. G.; Skitovich, V. I.; Soldaeva, L. S.; Konstantinov, I. E. At. Energ. (USSR); 32: No. 6, 488-9(Jun 1972). (In Russian).

The effectiveness of trapping 0.05 to 0.5 μ aerosols with fibrous filters was investigated with a variety of filters differing in the fiber diameter and thickness of the layer. The coefficient of filtering effectiveness was measured as a function of the filtering velocity for various particle diameters. The diameter distribution of some radioactive particles was measured for ^{95}Zr, ^{95}Nb, ^{144}Ce, ^{7}Be, ^{103}Ru, ^{106}Rh, and ^{137}Cs. (K.S.W.)

56106 COLLECTION OF UNATTACHED RaA ATOMS USING A WIRE GAUZE. James, A. C.; Bradford, G. F.; Howell, D. M. (National Radiological Protection Board, Sutton, Eng.). J. Aerosol. Sci.; 3: No. 4, 243-54(Jun 1972).

A 200 mesh wire gauze was found to collect airborne unattached RaA with an efficiency of more than 98%, at an air-sampling rate of 10 l/min through an area of 14 cm^2. Collection of RaA attached to condensation nuclei having a diffusivity of 10^{-5} cm^2/sec was estimated to be of the order of one per cent. The α activity collected on the gauze could be counted with the same efficiency as that for attached material collected on a back-up filter, when the airborne activity was sampled at 10 l/min. A simple "cylindrical diffusion tube" model adequately represented the collection of free RaA atoms on the wires of the gauze. (auth)

Soil

56107 RADIUM CONTENT OF SOILS IN REGIONS WITH A HIGH RADIATION BACKGROUND AND THE EFFECT OF FERTILIZERS ON RADIUM MOBILITY. Rusanova, G. V. pp 22-33 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

It was established that the radium content of gleystrongly-podzolic soils in regions with a high radiation level is equal to 10^{-7}%, that is by 4 orders higher than its clark content in the soil. A certain part of the radium in the soil is in a mobile state and is carried with the downward water flow into the lower horizons. Experimental investigations in cultivated soddy-meadow soil have shown that radium mobility and its entry into plants are reduced by the application of organic fertilizers and lime. Superphosphate on the contrary enhances the mobility of radium. (auth)

56108 DISTRIBUTION OF URANIUM AND RADIUM IN THE PODZOLIC MOUNTAIN SOILS OF THIN FORESTS. Rubtsov, D. M. pp 42-53 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The content and distribution of uranium and radium in the profiles of podzolic mountain soils of thin forests were determined. A tendency was discovered to a preferential accumulation of uranium and radium in the products of soil formation (aleurite as compared with base rocks) by sericitic shists with quartzite intercalations. The presence of uranium and radium in the vegetative objects of forest litters confirms the already established fact that uranium and radium are involved in the biological cycle of matter exchange in nature. The distribution of radium and uranium in soil profiles reflects the zonal features inherent in the given bioclimatic zone. In base rocks and soils, the equilibrium between radium and uranium is disturbed in favor of radium. In the order of decreasing energy of their absorption by vegetative objects radioactive elements form the series: radium > uranium > thorium. (auth)

56109 THORIUM AND RADIUM CONTENT IN THE SILT FRACTION OF THE PODZOLIC MOUNTAIN SOILS OF THIN FORESTS. Rubtsov, D. M. pp 53-66 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Investigations have shown that in zones of ore manifestation, thorium is associated with the coarse dispersed part of aleurite. In the zone of the halo of dispersion and the zone of background areas, thorium represented by the fine dispersed fraction is prevailing. The distribution of the silty thorium fraction in different soil profiles is determined by the nature of soil forming processes and the thorium content of aleurite and correlates in a certain measure with the composition of the plant association. The presence of thorium in separate fractions of organic matter was ascertained. The amount of uranium in the soils considered varies within the range of the geochemical background of uranium content in the soils of the Russian plain. Uranium is confined mainly to the fraction >0.001 mm. The distribution of the uranium of the silty fraction along soil profiles is determined, like that of thorium, by the nature and trend of the process of soil formation. Uranium enters the vegetative objects of forest litters far more intensely than thorium. (auth)

56110 CONTENT AND DISTRIBUTION OF URANIUM, RADIUM, AND THORIUM IN MOUNTAIN TUNDRA SOILS. Rubtsov, D. M.; Pravdina, E. I. pp 67-86 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Investigations of the content and distribution of thorium, uranium, and radium in mountain tundra soils showed a differentiation of their content according to genetic soil horizons, determined by the nature of the processes of formation. The absolute biological accumulation of thorium and uranium was found to be lower in the soils of mountain tundras as compared with the more southern mountain tundra soils of thin forests. Against a background of a reduced absolute biological accumulation of thorium and uranium in mountain tundra soils, an increase is observed of the relative coefficient of the participation of thorium and uranium in the biological cycle of matter exchange. (auth)

56111 CONTENT OF RADIOACTIVE ISOTOPES OF THE URANIUM AND THORIUM SERIES IN SOILS. Ovchenkov, V. Ya.; Rubtsov, D. M. pp 86-94 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Investigations of the radioisotope composition of soils in region with a high natural radiation background showed that the soils of sites with a high radiation level differ sharply from control sites in regard to their content of radioisotopes of the uranium and thorium series. A feature common to all the soils investigated is the presence of thorium in concentrations exceeding by 1.5 to 3.5 times the mean thorium content in the soils of the Russian plain. On the basis of this character, the region investigated may be recognized as a geochemical province. A high content of radioactive isotopes (with the exception of thorium) is found mainly in the 0 to 25 cm layer. The soils of radium sites contain high (as compared with the state of radioactive equilibrium with Th) amounts of MsTh$_1$, RaTh, ThX. Uranium—radium sites have a high uranium, radium, and thorium content in the upper horizons. At a depth of 25 to 125 cm (radium sites), a radioactive equilibrium is observed in the thorium series up to RaTh. The lower radiation level in radium sites is accounted for not only by the migration of isotopes but also by the decrease of RaTh and MsTh$_1$ in the process of radioactive decay. (auth)

56112 RADIUM MIGRATION FROM SITES OF ITS CONCENTRATION UNDER NATURAL CONDITIONS. Ovchenkov, V. Ya. pp 147-53 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The results of laboratory experiments are corroborating the statement that, other conditions being equal, the passage of radium from natural substrates into the liquid fraction is determined by the nature of the substrate and the form in which the radioelement occurs in it. Radioactive rocks, clays, and soils contain but small amounts of mobile forms of radium. The desorption of radium from these substrates is quite insignificant. In sand and in sand with various admixtures, radium is less solidly bound and may, under certain conditions, pass practically entirely into the liquid phase. (auth)

56113 ^{239}Pu AND ^{241}Am CONTAMINATION IN THE DENVER AREA. Poet, S. E.; Martell, E. A. (National Center for Atmospheric Research, Boulder, Colo.). Health Phys.; 23: No. 4, 537-48(Oct 1972).

Procedures and results of an experimental investigation of ^{239}Pu and ^{241}Am contamination in the environs of the Rocky Flats plutonium plant and elsewhere in the greater Denver area are presented and discussed. Measurements of ^{239}Pu and ^{90}Sr in the top 1 cm surface layer of soils showed that in this layer the ^{239}Pu contamination on offsite areas just east of the Rocky Flats plant ranges up to hundreds of times that from nuclear tests. In the more densely populated areas of Denver the Pu contamination level in surface soils is several times fallout. The depth distribution of ^{239}Pu in undisturbed soils in the more heavily contaminated areas show that the contamination is concentrated largely in a thin surface layer. Results for soils of known last date of disturbance showed that most of the offsite Pu accumulated between 1966 and 1969. This corresponded to the period in which Pu in an oil spill area on the plant site was exposed and subjected to wind reentrainment. ^{241}Am, which grows in from ^{241}Pu present in the contaminant, now contributes between 3 and 15% as much alpha activity as ^{239}Pu and ultimately will approach comparable levels. The important unknowns and uncertainties involved in the estimation of inhalation exposures and the carcinogenic risks from the ^{239}Pu contamination in the environs of Rocky Flats are briefly reviewed. (auth)

56114 NATURAL LEACHING OF ^{90}Sr FROM SOILS. Kogotkov, A. Ya.; Belova, E. I. Gig. Sanit.; No. 5, 111-13 (May 1972). (In Russian).

The ^{90}Sr distribution profiles were observed for a number of years in turf-podzol and in black earth soils in experimental plots which were contaminated with ^{90}Sr in a controlled manner. The data indicate that a significant difference exists in the retention of ^{90}Sr by the two soils; the period of half-removal from the black earth soil under natural conditions was greater than that period characterizing the turf-podzol soil. (K.S.W.)

56115 SORPTION OF ^{137}Cs AND ^{90}Sr ON CZECHOSLOVAK SOILS IN THE PRESENCE OF COMPETITIVE IONS. Benes, Jaroslav (Lab. of Radiological Dosimetry, Prague); Dlouhy, Zdenek. Jad. Energ.; 18: No. 9, 312-15(Sep 1972). (In Czech).

Among the Czechoslovak soils the highest degree of ^{137}Cs and ^{90}Sr sorption was found with chernozem, the lowest degree with podzolic soil. Sorption was conspicuously affected by an excess of competitive ions. Agents were found to transfer both radionuclides into solution from any soils occurring in the CSSR. (auth)

Water

Refer also to abstract 58409.

56116 (COO—3371-1) INTERCALIBRATION AND INTERCOMPARISON STUDY OF RADIONUCLIDE CONCENTRATIONS IN LAKE MICHIGAN SAMPLES. Progress Report, October 1, 1971—March 31, 1972. Maletskos, Constantine J. (New England Deaconess Hospital, Boston, Mass. Cancer Research Inst.). 1972. Contract AT(11-1)-3371. 26p. Dep. NTIS.

An intercalibration (measurements on aliquots of the same sample)/intercomparison (measurements on aliquots of the same source) program has been conducted by national laboratories and laboratories under contract to the Atomic Energy Commission. The initial plans were to compare many samples from Lake Michigan for radionuclide and stable element concentrations in order to assess the status, in freshwater samples as opposed to seawater samples, of laboratories especially capable of low-level environmental measurements. A limited response has been obtained from eight laboratories for radionuclides on samples of lake water, lake water spiked with known mixtures of radionuclides (^{54}Mn, ^{60}Co, ^{65}Zn, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{90}Sr, and ^{239}Pu) prepared by the National Bureau of Standards, and lake sediment from the effluent channel of a nuclear power plant, and from two laboratories for stable elements on samples of lake bottom sediment. The evaluation indicates that the precision and accuracy of these select laboratories is much better than that found in an open program. Even so, some discrepancies occur which suggest both systematic and variable errors. The variability of $\sim\pm15$ to 30% in the measurement of the γ-emitting elements is unexplainedly constant over a concentration range covering 4 to 5 orders of magnitude. There is a possible suggestion that Sr and Pu, involving chemical procedures, can be measured as well as or better than the γ emitters. The response on trace elements was very low, but, while the results were encouraging, no deductions could be made. The use of National Bureau of Standards spiked water samples for radionuclide mixtures was very useful and should be considered in all such programs both for radionuclides and trace elements. The evaluation indicated that environmental samples can be measured reasonably well by competent laboratories but that the capability for routine environmental monitoring will not easily approach that of these laboratories. (auth)

56117 (COO—3563-5) GENERAL SUMMARY OF PROGRESS, 1971—1972. Bowen, Vaughan T. (Woods Hole Oceanographic Institution, Mass.). 1972. Contract AT(11-1)-3563. 72p. Dep. NTIS.

Developments are reported for studies on: quality control data for radiochemistry and interlaboratory comparisons; ^{90}Sr and ^{137}Cs in Atlantic Ocean surface water; vertical penetration of fallout in Atlantic Ocean Water Columns; radionuclides in sediments; Pu, Am, and Pn radiochemistry; geochemical reference materials and standards; elemental composition of Coccolithophorida; Ba uptake by diatoms; and the elemental composition of some marine sponge species. (P.C.H.)

56118 (NVO—1229-175) RADIOACTIVITY IN WATER. CENTRAL NEVADA TEST AREA. Nork, W. E.; Forslow, E. J.; Essington, E. H. (Teledyne Isotopes, Las Vegas, Nev.). Sep 1971. Contract AT(29-2)-1229. 84p. Dep. NTIS.

Experience associated with Project Shoal and Project Long Shot has demonstrated the necessity for documenting pre-detonation background radioactivity levels in environmental waters. Possible natural fluctuations and cyclic variations in background radioactivity levels in water may be distinguished from explosion-produced radioactivity by long-term sequential sampling and analysis. A plan for multiple sampling and analysis for the Central Nevada Test Area (CNTA) was prepared and implemented. Low-level tritium and gross radioactivity analyses for background determinations were made on water samples collected from the CNTA. A series of samples were collected from sampling points of interest at various times and analyzed. Lower limits of tritium and gross radioactivity concentrations in water were reasonably well established. Determination of background radioactivities due to naturally occurring radionuclides in water was established for all proposed sites in Central Nevada. After selection of Hot Creek Valley as the CNTA, sampling efforts were concentrated there and the frequency of sampling at other locations diminished. Hydraulic test data from wells were analyzed to determine the potential migration characteristics of contaminants in the ground water system. Radionuclide migration through geologic media is governed by the combined effects of water velocity and retardation of the radionuclide by sorption and dispersion. The degree of radionuclide sorption and retardation are approximated in the laboratory by measurement of distribution of a radionuclide between the mineral and solution phases. A number of samples from UCe-18 indicated natural radioactivity levels above the reference Concentration Guide values. Specific radiochemical analyses indicated that the radioactivity was due to the presence of natural uranium. Samples taken in Faultless re-entry drill hole UC-1-P-2SR were analyzed for comparison with pre-event background levels of tritium and gross radioactivity. (auth)

56119 (RLO—2225-T-20-6) RADIOCARBON IN THE SEA. Fairhall, A. W.; Young, A. W.; Bradford, P. A. (Washington Univ., Seattle. Dept. of Chemistry). 1971. Contract AT(45-1)-2225. 14p. (CONF-721019—1). Dep. NTIS.

From International radiocarbon dating conference; Wellington, New Zealand (18 Oct 1972).

The results of measurements on ^{14}C in the sea are reported. The results implied a nearly constant level of natural ^{14}C, independent of depth or location, at a value of $1.42 \pm 0.02 \times 10^{9}$ ^{14}C atoms/l. Decay of natural radiocarbon was presumably balanced by redissolution of organic carbon from the surface. The influence of bomb ^{14}C in the upper kilometers of the ocean was quite apparent. The trend was roughly linear with depth. Data from various weather stations in the Atlantic and Pacific Oceans are presented in graphical form. (P.C.H.)

56120 RADIONUCLIDES AS POSSIBLE SEA WATER POLLUTANTS. Keckes, S. (Lab. of Marine Radioactivity, Monaco); Bernhard, M. Rev. Int. Oceanogr. Med.; 20: 1-20(1970). (RT/-BIO(72)16).

Man-made radionuclides released mainly as by-products from nuclear power plants, installations for production or reprocessing of nuclear fuel, and from weapon tests should be considered as possible pollutants of the seas and oceans. The marine biogeocycle of the radionuclides follows the biogeocycle of the corresponding stable element. Apart from the radioactive decay, some of the most important processes of this biogeocycle are: physicochemical speciation and equilibration with the corresponding stable element; dilution and dispersion by diffusion and advection; transport from the point of entry by currents and migrating organisms; and concentration by organisms directly from seawater or through food chains and by physicochemical processes leading finally to removal by sediments. Radionuclides through their radiations may cause somatic and genetic damage to marine organisms and to man. The hazard of this damage, often irreparable, is proportional to the level of environmental radioactivity. There is no safe level of marine radioactivity, and therefore, the limit of risk must be set consciously in regard to the benefits from the atom age. (auth)

56121 POSSIBLE ROLE OF MARINE BACTERIA IN THE RECYCLING OF RADIONUCLIDES IN SEAWATER. Peroni, C. (CNEN—EURATOM, La Spezia, Italy). Rev. Int. Oceanogr. Med.; 20: 1-25(1970). (RT/BIO(72)14).

The role performed by bacteria in the marine ecosystem is little known since only very few strains can be cultured and then studied. Furthermore, the bacterial count methods commonly used give very different results about their number in the sea. In the light of these considerations, the possible functions performed by bacteria in the marine environment are suggested, with particular regard to the transfer of radionuclides through the marine food chain. A review is given of the few data in the literature concerning the uptake of the radionuclides of Sr, Y, Ca, Zn, Cs, and Ce by marine bacteria and the transfer of the radioisotopes ^{32}P and ^{54}Mn to higher trophic levels by bacteria associated with marine animals. A few examples are also given of food chains whose first step is represented by the utilization of dissolved organic matter by bacteria. Finally, the relationship between organic matter present in the marine environment and the number of metabolically active bacteria detected by an autoradiographic method is discussed. (auth)

56122 GAMMA-RADIATION FIELD IN THE UPPER LAYER OF THE BLACK SEA. Batrakov, G. F.; Belyaev, B. N.; Vinogradov, A. S.; (and others). At. Energ. (USSR); 33: No. 3, 785-8(Sep 1972). (In Russian).

Spectra of γ radiation were determined at depths of 10, 75, and 200 meters in the Black Sea. A photopeak of scattered radiation was observed in the weak energy end of the spectra at all depths, and this photopeak was generally identified with ^{40}K. The fall-off in intensity in the soft region of the spectrum near the ocean surface is caused not only by absorption of cosmic radiation but also by the change in total specific activity of the isotopes contained in the water. The specific activity of ^{40}K was characterized by considerable variation with depth, and the variation in the γ field was useful in evaluating the structure of the hydrophysical fields with a typical scale of the order of 10^{-1} to 10 meters. (K.S.W.)

56123 DATA. SECTION II. WATER. Radiat. Data Rep.; 13: No. 7, 403-5(Jul 1972).

Data on the gross alpha and beta radioactivity of water samples collected from 10 U.S. rivers during November 1971 are tabulated. (L.C.L.)

56124 ^{228}Ra PROFILE AT THE SECOND GEOSECS INTERCALIBRATION STATION, 1970, IN THE NORTH ATLANTIC. Trier, R. M. (Columbia Univ., Palisades, N. Y.); Broecker, W. S.; Feely, H. W. Earth Planet. Sci. Lett.; 16: No. 1, 141-5(Sep 1972).

^{228}Ra concentrations were measured in 12 subsurface water samples collected during Aug. and Sept. 1970 in the North Atlantic at the Second Geosecs Intercalibration Station. ^{228}Ra concentrations ranged from 1.5 to 2.1 dpm/100 kg in the water layer between 100 and 600 m depth, above the main thermocline, but decreased with increasing depth to less than 0.5 dpm/100 kg at 1.5 km, below the main thermocline. The two deepest samples, collected below 4 km depth, indicated that the ^{228}Ra concentration increased again to at least 1.2 dpm/100 kg as the interface with the sea floor sediments was approached. Above the 4 km level, the ^{228}Ra profile was roughly similar to the tritium profile measured by Roether and Münnich. (auth)

56125 ^{7}Be AND FISSION PRODUCTS IN THE GEOSECS II WATER COLUMN AND APPLICATIONS OF THEIR OCEANIC DISTRIBUTIONS. Silker, Wyatt B. (Batelle-Northwest, Richland, Wash.). Earth Planet. Sci. Lett.; 16: No. 1, 131-7(Sep 1972).

Vertical concentration gradients of ^{7}Be and ^{95}ZrNb in the Atlantic Geosecs II water column provided values for the vertical eddy diffusion coefficient of 1.2 to 1.3 cm^{2}/sec through the top sixty meters of the thermocline. Lower values of the diffusion coefficient calculated from the longer-lived nuclides ^{106}Ru and ^{144}Ce suggest horizontal transport of the deeper water from areas of lower fallout levels. Temporal and spatial oceanic distributions of ^{7}Be are analyzed with respect to their application for use in predicting deposition of other radionuclides which are present in the atmosphere. Finally, an approach is suggested by which the ratios of air concentrations of radioactive tracers, together with known variations of ^{7}Be in the ocean, could be applied in the development and proof of a dynamic model of oceanic circulation and transport. (auth)

56126 TRITIUM PROFILE AT THE ATLANTIC 1970 GEOSECS TEST CRUISE STATION. Roether, W.; Muennich, K. O. (Univ., Heidelberg). Earth Planet. Sci. Lett.; 16: No. 1, 127-30(Sep 1972).

Tritium concentrations at the Atlantic 1970 Geosecs station (R. V. Knorr, August/September 1970, appr. 36°N, 68°W) are reported. The tritium concentration is 8.5 TU at the surface, and it drops markedly between 600 and 1000 m depth to below 1 TU. Tritium concentrations significantly exceed zero down to about 2000 m depth. The tritium profile reflects the hydrographic structure at the station. Local vertical mixing can be excluded as the source of the tritium found below 1000 m depth. (auth)

56127 EXCESS ^{3}He IN THE ATLANTIC OCEAN. Jenkins, W. J. (McMaster Univ., Hamilton, Ont.); Beg, M. A.; Clarke, W. B.; Wangersky, P. J.; Craig, H. Earth Planet. Sci. Lett.; 16: No. 1, 122-6(Sep 1972).

^{3}He/^{4}He measurements at two stations in the Atlantic show that the deep water (>2 km) contains far less excess ^{3}He than previous measurements have shown for the Pacific Ocean. The ^{3}He/^{4}He ratio anomaly (relative to atmospheric ^{3}He/^{4}He) is approximately 5% for the deep Atlantic compared to about 20% for the deep Pacific. The North Atlantic ^{3}He profile shows much more structure than the South Atlantic profile, with maxima observed at 500 m, 1900 m, and 3200 m. The maxima at 500 m and 1900 m are probably due to in situ tritium decay, whereas the 3200 m maximum cannot be due to tritium, and is probably due to leakage of ^{3}He into the Atlantic water from the mantle. It seems significant that maxima in the trace elements Cu, Zn and Fe have also been observed at 3200 m at this station by Brewer, Spencer and Robertson. (auth)

56128 TRACE ELEMENT PROFILES FROM THE GEOSECS-II TEST STATION IN THE SARGASSO SEA. Brewer, P. G. (Woods Hole Oceanographic Institution, Mass.); Spencer, D. W.; Robertson, D. E. Earth Planet. Sci. Lett.; 16: No. 1, 111-16 (Sep 1972).

During the GEOSECS-II test cruise a profile of 25 large volume water samples were collected, filtered and stored in the acidified conditions. Two laboratories have together determined Fe, Cu, Zn, Co, Sb, Cs and U in these samples. Both laboratories determined Zn and the correlation is good; Zn, Fe and Cu show a maximum in the North Atlantic Deep Water, Cs and U are essentially conservative and Sb shows variability within the uncertainty of the technique. Sc is more abundant in deep water than surface water in both the Atlantic and Pacific Oceans. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 56039, 56235, 56388, 56455, 56514, 56526, 56552–56555, 56574, and 56575.

56129 (NP–19433) ANNUAL MEAN CONTAMINATION OF MILK BY ^{90}Sr AS A FUNCTION OF 7 FRENCH CLIMATES. **(Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 1972. 20p. (In French). Dep. NTIS (U. S. Sales Only).**

Data are given on the contamination of milk in France in seven different climates by ^{90}Sr for 1965 through 1971 and by ^{137}Cs for 1968 through 1971. The seven regions surveyed include Viomenil, Meaudre, Sauveterre, Nainville, Cleville, Bellenaves, and Anglade. Data are also given on the contamination of human bones by ^{90}Sr for the years 1965 through 1970 and for tritium contamination of personnel for the years 1968 through 1970. (P.C.H.)

56130 (NP–19434) ENVIRONMENTAL RADIOACTIVITY. **Data on Milk Contamination Level in the World, 3rd Quarter 1971. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 24p. (In French and English). Dep. NTIS (U. S. Sales Only).**

The results of milk surveillance for ^{137}Cs and ^{90}Sr for the 3rd quarter of 1971 are presented. The countries in which milk was sampled include Sweden, Canada, United States, France, and New Zealand. The results showed that the ^{90}Sr content was comparatively stable for all the stations of the northern and southern hemispheres. More important fluctuations were observed for ^{137}Cs than for ^{90}Sr during the third quarter, and low increase of the average activities was noted in the northern hemisphere. (P.C.H.)

56131 (NP–19436) ENVIRONMENTAL RADIOACTIVITY. **Data on Milk Contamination Level in the World, 4th Quarter 1971. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 24p. (In French and English). Dep. NTIS (U. S. Sales Only).**

The results of milk surveillance for ^{137}Cs and ^{90}Sr for the 4th quarter of 1971 are presented. The countries in which milk was sampled include France, Sweden, Canada, United States, and New Zealand. The results showed that during the 4th quarter the ^{90}Sr content was slightly decreased in the northern hemisphere but remained comparatively stable in the southern hemisphere. More important fluctuations for ^{137}Cs than those observed for ^{90}Sr appeared. A low decrease of the average activities were observed in the northern hemisphere and a low increase appeared in the southern one. (P.C.H.)

56132 (NP–19437) ENVIRONMENTAL RADIOACTIVITY. **Data on Milk Contamination Level in the World, January 1970–June 1971. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 39p. (In French and English). Dep. NTIS (U. S. Sales Only).**

The results of milk surveillance for ^{137}Cs and ^{90}Sr for the year 1970 and the first half of 1971 are presented. The countries in which milk was sampled include France, Sweden, Canada, United States, and New Zealand. The results showed that from Jan. 1970 to June 1971, the ^{90}Sr content was comparatively stable for all stations of the northern and southern hemispheres. For ^{137}Cs more important fluctuations than those observed for ^{90}Sr appeared, and an increase in the average activities during the third quarter of 1970 was noted in the northern hemisphere. (P.C.H.)

56133 RADIOACTIVE CONTAMINATION OF FOODSTUFF IN THE NORTHERN DISTRICTS OF GDR DURING THE PERIOD 1965–67. Randow, F.; Schulze, H.-A. (Univ., Rostock, Ger.). Gesam. Hyg. Ihre Grenzgeb.; 15: 261-7(Apr 1969). (In German).

The radioactive contamination of foodstuffs was measured in the northern districts of the GDR (Rostock, Neubrandenburg, Schwerin during the period from 1965 to 1967 by numerous determinations of the ^{90}Sr- and ^{137}Cs-content of milk and milk products, cereals and cereal products, vegetables, fruit, and luxury foods. As compared to 1966, milk (in 1967 about 8 pCi ^{90}Sr/l and about 21 pCi ^{137}Cs/l) and milk products show a decrease of the contamination rate by about 50%. In 1967, the contamination of the cereals rye, wheat, barley, and oat ranged from 19 to 44 pCi ^{90}Sr/kg and from 24 to 42 pCi ^{137}Cs/kg. We recorded a decrease of the ^{137}Cs contamination in 1966 and 1967 to about one third of the value of the preceding year. In 1967, the ^{90}Sr contamination decreased to 50% of the values of the preceding year. The general reduction of the radionuclide content is also revealed with the cereal products. During the period of observation, we could not ascertain any changes of the contamination of vegetables (potatoes: 5 to 11 pCi ^{90}Sr/kg, 9 to 10 pCi ^{137}Cs/kg; carrots: 14 to 57 pCi ^{90}Sr/kg, 6 to 8 pCi ^{137}Cs/kg) and fruits (apples, pears, and tropic fruits: 1 to 89 pCi ^{90}Sr/kg, 2 to 33 pCi ^{137}Cs/kg). Of the luxury foods analyzed, crude coffee and tea showed a rather high radionuclide content (526 to 3693 pCi ^{90}Sr/kg, 511 to 1517 pCi ^{137}Cs/kg). (auth)

56134 RADIOEKOLOGICHESKIE ISSLEDOVANIYA V PRIRODNYKH BIOGEOTSENOZAKH. (Radioecological Studies in Natural Biogeocenoses). Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). 267p.

A separate abstract was prepared for 20 of the 21 chapters in this book. The other chapter discusses the distribution and migration of calcium in podzolic soils. (E.R.B.)

For abstracts of individual chapters see: 55717, 56094, 56107–56112, 56135–56137, 56335, 56386, 56455, 56551–56554, 56574, and 56575.

56135 DISTRIBUTION OF NATURAL RADIOACTIVE ELEMENTS IN THE BASIC COMPONENTS OF NATURAL AQUATIC MICROBIOGEOCENOSES. Verkhovskaya, I. N.; Popova, E. I.; Vlasova, T. A.; Esova, G. I. pp 124-47 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The content, distribution, and translocation of radium, uranium, and thorium in the biotic and abiotic components of some aquatic microbiogeocenoses were studied under natural conditions. It was found that the grounds of aquatic biogeocenoses form a series in regard to the degree of radium accumulation: radium accumulates most intensely in silts, less in silty sands, and least in pure sands. The vertical stratigraphy of radium varies greatly depending on the nature of the component fractions, the presence or absence of macrophytes, etc. The degree of radium accumulation by plants is variable, owing to differences in the size of their adsorbing surfaces and the role of the roots and leaves in absorbing minerals from the water and the ground, the degree of the plant's submergence, which in its turn is determined by ecological and species specificity and peculiarities of structure. The radium content of the different components of one and the same body of water is subject to seasonal changes. In the summer, radium concentrates in aquatic plants. In the autumn, when the plants die, radium passes into the ground and the water of the stream, and is subsequently washed out and carried into the river (due to increased discharge caused by atmospheric precipitation). In the winter, some stabilization takes place. These are the principal stages of the annual cycle of radium translocation—dispersion within the biogeocenoses investigated. (auth)

56136 DETERMINATION OF RADON CONCENTRATIONS IN THE BURROWS AND REFUGES OF SOME BURROWING ANIMALS. Nikiforov, V. S.; Ovchenkov, V. Ya. pp 230-7 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

A method was developed and experimentally verified for the determination of radon concentrations in the burrows and refuges of animals referred to the radioecological group of close contact with the surroundings. The method is applicable to burrows with a volume of no less than 0.5 liters. A hermetization of entrances during the process of air sampling is not obligatory. Errors in the determinations of radon concentrations caused by a leakage of air from the soils forming the walls of the burrow or from the atmosphere are excluded when this method is used. The results obtained in the application of the method under natural conditions give grounds to suppose that a correlative dependence exists between the concentration of radon in the air of the burrows and the soil air of the sites where they had been unearthed. (auth)

56137 DISTRIBUTION AND REDISTRIBUTION OF URANIUM, RADIUM, AND THORIUM IN NATURAL BIOGEOCENOSES. Verkhovskaya, I. N.; Vavilov, P. P.; Maslov, V. I. pp 243-56 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The content, distribution, and redistribution of natural radioactive elements was studied in soils, aquatic and land vegetation, and animals in regions with high radiation levels, in different zones of the northern taiga. It was established that plants remove from the soil the soluble forms of radium, uranium, and thorium, which are carried with the upward water flow into the overground part of the plant. An acropetal gradient of radioelement distribution was noted as well as a higher content of the elements in older formations. It is shown that radioelements are not capable of being reutilized in the plants. Most intensively absorbed is radium, less intensively—uranium, and least of all—thorium. The ratios of the radioelements entering the plants do not correspond to their ratios in soils. The food relationships between wild animals and the relationships between the biotic and abiotic compounds of biogeocenoses were established, which permit the judgment of the translocation of radioelements. (auth)

56138 DATA. SECTION I. MILK AND FOOD. Radiat. Data Rep.; 13: No. 7, 393-402(Jul 1972).

Tabulated data on the ^{137}Cs and ^{90}Sr content in milk sampled at 74 locations in the Western Hemisphere (Canada, Central America, South America, and U.S.) are presented for March 1972 and for the period from Apr. 1971 to Apr. 1972. Mar. 1972 data on the ^{140}Ba, ^{131}I, and ^{89}Sr content in milk sampled at 7 U.S. stations are also included. (L.C.L.)

56139 TRITIUM TRANSFER TO FOOD ITEMS FROM TRITIATED METHANE USED FOR DOMESTIC COOKING. Patzer, R. G.; NcNelis, D. N.; Plott, W. F.; Moghissi, A. A. (Environmental Protection Agency, Las Vegas, Nev.). Health Phys.; 23: No. 4, 501-7(Oct 1972).

Various foods were cooked with tritiated methane gas and analyzed for tritium in the aqueous and dry portions of the food. The amount of tritium found in the food was directly related to exposed surface area, cooking time, and moisture content of the food. The specific activity of hydrogen was higher in surface than in interior portions of cooked food, e.g., the specific activity in surface and center portions of meat loaf were about 1 and 0.3%, respectively, of the specific activity in methane cooking gas. Approximately 0.5% of the total tritium in the methane used to cook a beef roast was found in the roast. The uptake rate of tritium into beef roast during cooking corresponds to an uptake rate of about 2 μg/cm^2-min of hydrogen from the methane. (auth)

56140 PROBLEMS ARISING FROM RADIOISOTOPES IN DOMESTIC ANIMALS AND FOOD STUFFS. Grossklaus, D. (Bundesgesundheitsamt, Berlin). Bundesgesundheitsblatt; 14: No. 4, 37-43(1971). (In German).

The article briefly discusses the problems of radioactive contamination by summarizing the sources of contamination representing a risk to animals that are of importance for man's nutrition (animals for slaughter, eggs, milk), as well as by describing the residues of these radioactive substances. It is shown that, for a variety of reasons, the peaceful utilization of nuclear energy can contribute to an increase in radioactive contamination. Emphasis is placed on the radionuclides ^{90}Sr, ^{137}Cs, and ^{131}I, of which ^{137}Cs plays an important part in veterinary medicine, as it shows a special affinity for meat. Up to ten percent of the amount of these radionuclides incorporated by ruminants can be excreted in the milk. (GF)

Radiometric Techniques

Refer also to abstract 56259.

56141 DETERMINATION OF THE AGE OF MINERALS BY MEANS OF TRACKS OF SPONTANEOUS FISSION OF URANIUM. Syromyatnikov, N. G.; Trofimova, L. A.; Ivanov, A. I. Vestn. Akad. Nauk Kaz. SSR; No. 11, 52-7(Nov 1971). (In Russian).

The relationship between the K–Ar age of biotites from granitoids and the density ratio of ^{238}U spontaneous fission tracks in the sample was studied. In nine samples of age 250 to 1,800 million years a satisfactory linear function was obtained; for a tenth sample an anomalously high track density/U content ratio was manifest, in disagreement with the K–Ar age. (K.S.W.)

56142 K/Ar AGE DETERMINATIONS ON ALKALINE OLIVINE BASALTS FROM SKAANE, SOUTHERN SWEDEN. Printzlan, Ivan (Mineralogisk Museum, Copenhagen); Larsen, Ole. Geol. Foren. Stockholm Forh.; 94: No. 549, 259-69 (24 Jun 1972).

The method of age determination with K/Ar is described. The radiogenic argon was determined by isotope dilution. The precision of this method is discussed. In most cases the precision is limited by the potassium determinations, which were made by atomic absorption. An error value is given to the age of each specific sample. The method is applied to alkaline olivine basalts from Skaane in southern Sweden. (Sweden)

56143 WHOLE-ROCK U–Th–Pb AND Rb–Sr AGES OF THE SYBELLA MICROGRANITE AND PEGMATITE, MOUNT ISA, QUEENSLAND. Farquharson, R. B.; Richards, J. R. J. Geol. Soc. Aust.; 17: No. 1, 53-8(1970).

Isochron data on the Sybella microgranite and pegmatite support recent age estimates on muscovite and monazite. From Rb–Sr, the age is 1553 ± 29 m.y., initial ratio 0.7323 ± .0101; from the three U–Th–Pb isochrons the pooled age is 1565 ± 52 m.y., initial ratios 17.530 ± .013, 15.639 ± .013, 36.443 ± .013. These lead ratios are so markedly different from those of the adjacent Ag–Pb–Zn orebody that they exclude any possible correlation between these components of the Sybella Granite and the mineralization. It is thought that Th–Pb data have not been used previously for deducing age and initial lead ratios. (auth)

56144 PROGRESS IN APPLICATIONS OF NUCLEAR TECHNIQUE IN GEOPHYSICS, MINING, AND HYDROLOGY IN POLAND. Czubek, Jan A. (Inst. of Nuclear Physics, Krakow); Florkowski, Tadeusz; Niewodniczanski, Jerzy; Przewlocki, Kazimierz Nukleonika; 16: No. 9-10, 493-511(1971).

Application of nuclear techniques in prospecting for and developing mineral resources has shown further progress since the last Geneva Conference both in research and in general use. The natural gamma-logging method has been refined by improvement in calibration and interpretation of results. In the gamma–gamma method a semiempirical method of calibration for density and chemical composition logging is introduced. For neutron logging a borehole neutron-pulsed generator has been constructed. The x-ray fluorescence method is used for evaluation of copper deposits (field instruments) and also in ore-plant laboratories for routine analysis (zinc–lead ores). The method has been also applied in field and laboratories for determining iron in ores, zircon in sands etc. Other laboratory radiometric methods including fast neutron and photon activation techniques were investigated. In hydrology radioactive tracer methods are used for investigating leakage from water reservoirs. For quantitative determination of filtration rate through the reservoir bottom the isotope instruments were constructed and successfully checked. Single-well and multi-well techniques are in routine field use for studying leakage rates or measurements of effective porosity and tightness of underground water screens. Some effort was spent on theoretical consideration of tracer dispersion in porous media where useful conclusions were drawn for field application. A number of new applications in the mining and progressing of coal and ores were proposed and demonstrated. Hydrotransport of sand and rock for back fill processes can now be fully controlled by radiometric methods measuring density, velocity of different fractions of solid phase etc. Deposited back fill parameters such as drying rate, changes in bulk density, anisotropy can be controlled by gamma and neutron probes with high accuracy. (auth)

56145 WELL LOGGING SYSTEM. Paap, Hans J.; Pitts, Robert W.; Mueller, Allen H. (to Texaco Inc.). U. S. Patent 3,681,601. 1 Aug 1972. Filed 1 Jun 1970.

A system for logging a borehole traversing earth formations wherein a logging tool, or sonde, connected to the end of an electrical cable traverses the borehole; the sonde containing nuclear or radioactivity logging apparatus such as, for example, a scintillation detector including a photomultiplier and associated circuitry for generating output information signals representative of at least one parameter (e.g., nature of subsurface formations or strata) determined in the borehole is described. The output information signals initially generated in the sonde are electrical pulses having a short-duration as well as short rise and short decay times. However, after being transmitted along the cable from the sonde to the earth's surface these pulses become distorted into pulses having a long duration attenuated amplitude, long rise, and long decay times. A pulse shaping network, located at the earth's surface, to restore the amplitude, duration, rise and decay times of the pulses so that the reshaped pulses can be fed to, inter alia, a pulse height analyzer whereby useful logging information may be derived from the reshaped pulses in correlation with the depth of the sonde in the borehole is described. (Official Gazette)

56146 URANIUM-SERIES SYSTEMATICS IN NATURAL MATERIALS FROM THE NEWPORT AREA, OREGON. Szabo, B. J. (Geological Survey, Denver). U. S. Geol. Surv., Prof. Pap.; No. 800-C, 199-201(1972).

Analyses of uranium, thorium, and protactinium isotopes in recent and fossil wood and kelp samples from the Newport area, Oregon, indicate that migration of these radioelements has been extensive. Thus, this type of material at this location is unsuitable for uranium-series dating. The analytical data from a shell sample from the same area showed evidence of recent uranium assimilation, which contributed to a minimum age estimate only. (auth)

56147 LEAD-ISOTOPE AGE AND U–Pb DISCORDANCE OF PRECAMBRIAN GNEISS FROM GRANITE MOUNTAINS, WYOMING. Nkomo, I. T.; Rosholt, J. J. (Geological Survey, Denver). U. S., Geol. Surv., Prof. Pap.; No. 800-C, 169-77(1972).

Lead isotopic composition and concentration in six paragneisses, a granitic gneiss, and two granites from the Granite Mountains area, Wyoming, were determined on whole-rock samples and seven associated feldspars. Uranium and thorium contents also were determined for the whole rocks and for three of the feldspar samples. The $^{207}Pb/^{204}Pb$ versus $^{206}Pb/^{204}Pb$ data from the whole rocks define a line with a slope equivalent to a 2,950 ± 120-m.y. isochron. The age indicated by this isochron is similar to the 2,925 ± 80-m.y. age obtained, by the Rb/Sr method, in another study on the same group of whole rocks and may indicate the time of major metamorphism of these rocks. Lead–uranium and lead–thorium relations show marked discordance and cannot be used to calculate ages. In the whole-rock samples, uranium loss seems to have predominated during the Cenozoic. The age of gneiss in this study indicates the preexistence of a solidified crust older than 2,950 m.y. (auth)

Site Surveys

Refer also to abstract 58081.

Thermal Effluents

Refer also to abstracts 55967, 56572, 58203, 58288, and 58409.

56148 RESEARCH NEEDS ON WASTE HEAT TRANSFER FROM LARGE SOURCES INTO THE ENVIRONMENT. Conference Held at Urbana, Illinois, September 20–24, 1971. Urbana, Ill.; Illinois State Water Survey (1971). 39p. (CONF-710967).

A conference was held to evaluate research needs on problems of waste heat transfer from large thermal sources, such as electric generating plants, into the environment. A group of 27 experts from a broad cross section of professional activities reviewed the knowledge of present and projected environmental effects resulting from large injections of waste heat into the environment by means of wet and dry cooling towers and cooling ponds, lakes, and streams. Complicated interactions of the physical, engineering, biological, social, and economic factors are discussed in this report which focuses on key problem areas and suggests needs and directions for further research and action. Various alternatives for waste heat disposal are listed. Alternatives relative to various climatic regimes and local resources in order that environmental consequences might be minimized without excessive delays and costs are reviewed. (auth)

56149 METHOD FOR MINIMIZING EFFECTS OF WASTE HEAT DISCHARGES. Jeffers, F. J. (Baltimore Gas and Electric Co.). Int. J. Environ. Stud.; 3: No. 4, 321-7(Sep 1972).

A method is presented for minimizing the environmental effects of the once-through system of power plant condenser cooling. This method involves the determination of the adequacy of the heat assimilative capacity of the waters which receive the condenser cooling water discharge; the investigation of the physical characteristics of the water body with particular regard to current flow patterns and development of temperature, salinity and dissolved oxygen profiles; the selection of design criteria for the protection of the aquatic life; and the prediction by analytic methods or hydraulic model studies of the distribution and magnitude of excess temperatures in the receiving waters expected to result for various designs of the plant intake and discharge structures. (auth)

56150 HAZARDS TO RIVERS BY COOLING WATERS OF NUCLEAR POWER PLANTS. Hoell, K. Staedtehygiene; 22: No. 12, 280-3(1971). (In German).

The heating of the river water by hot cooling water of nuclear plants causes enormous multiplication of bacteria, reduction of oxygen, dying of fishes, bad smell etc. Within the "nukes" the cooling water has its optimal temperature for pathogen germs, but at this temperature of 38°C annihilators of germs have to die. The result is that the germs multiply. The heated river water containing organic matter gives very good conditions for the appearance of blue algae and their poisonous secretions. (INIS)

56151 PRESENT COOLING-WATER SITUATION IN THE FEDERAL REPUBLIC. Krolewski, H. (Vereinigte Elektrizitaetswerke Westfalen AG, Dortmund, Ger.). Tech. Mitt.; 65: No. 5, 193-200(1972). (In German).

The following topics are reviewed: status of power plant and nuclear power plant technology; development of waste heat quantities; possibilities of heat removal; official specifications concerning the thermal loading of waters; effects of the artificial heating of waters; hydroeconomical viewpoints; and research projects and aims. (GF)

56152 ENVIRONMENTAL PROBLEMS ARISING FROM OPERATION WITH COOLING TOWERS: QUANTITIES AND DISCHARGE OF DISSOLVED AND NON-DISSOLVED SUBSTANCES. Resch, G.; Burgmann, F. (Vereinigte Elektrizitaetswerke Westfalen AG, Dortmund, Ger.). Tech. Mitt.; 65: No. 5, 237-9(1972). (In German).

A brief review is given of the following problems: water chemistry limits to the circulation of cooling water; effects of water quantities on economic planning; processing of additional water; residues resulting from different processing methods; effects of the cooling tower holder on the waste quality; and the discharge or removal of waste sludges after processing. (GF)

56153 THERMAL WATER MULTI-USE DEMONSTRATION. Kligfield, George (Vitro Engineering Co., New York). pp 700-10 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Putting waste energy to work through the multi-use of thermal effluent is one answer to Thermal Pollution. A demonstration project described, which has used effluent from condensers for the past two years, has shown that multi-use is feasible for frost protection of fruit and ground plants, extension of crop growing season, and protection of fruit from excessive dry climate and sunburn, as well as normal irrigation. Benefits can be achieved in the multi-use of power and industrial plants' thermal effluents. Included is a brief history of the origin of the project, and the concept of a nuclear community. (auth)

56154 ECOLOGICAL-ENGINEERING STUDY OF AN AGRICULTURAL OR SILVACULTURAL SYSTEM UTILIZING HEATED WATER FROM POWER PLANTS. Ludlam, Stuart D.; McGowan, Jon G. (Univ. of Massachusetts, Amherst). pp 711-21 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A descriptive analysis of a model of an auxiliary system to dissipate waste heat from electrical power plants is presented in terms of an initial engineering feasibility and ecological effects study. The total system is designed for silvacultural application and is composed of an ecosystem consisting of engineering, atmospheric, biological, and watershed subsystems. In addition to a general characterization of the various subsystems and the interfaces between them, a preliminary design study of a system utilizing the heated water to irrigate a forest system is presented. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 56509.

General Detectors and Monitors

Refer also to abstracts 56355, 56487, 56508, 56544, and 57927.

56155 (AECL–4213, pp 43-63) HEALTH PHYSICS. Jun 1972.

Topics include spark counting technique for damage track dosimeter measurements, fast spectra resulting from moderation of fission neutrons, counting Rh x-rays from thick foils, Rh gamma rays from inelastic neutron scattering, thermoluminescence dosimetry, semiconductor detectors, Geiger counters, monitoring for tritium in air and water, portable fluorimeter health instruments, detection of iodine in air, microscopic flying-spot scanner, specimen preparation for heavy atom imaging by phase contrast electron microscopy, and routine dose monitoring. (W.H.K.)

56156 (AECL–4303) DEVELOPMENT OF A MONITOR FOR TRITIATED WATER VAPOUR IN THE PRESENCE OF NOBLE GASES. **Osborne, R. V. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Sep 1972. 18p. Dep. NTIS (U. S. Sales Only). AECL $0.50.**

Fission product noble gases (^{87}Kr, ^{133}Xe, etc.) or ^{41}Ar often accompany tritiated water escaping from reactor systems. When the concentrations of gases are more than two orders above that of the tritiated water vapor (HTO$_v$), gas phase monitors (e.g. ionization chambers) are impractical. The principles of a monitor for HTO$_v$ in these conditions were outlined recently. An HTO$_v$/water exchanger is used with plastic or liquid scintillator as detector for tritiated water in a single sample type liquid scintillation counter. Noble gases are very inefficiently trapped, relative to HTO$_v$, in the water. In the current prototype using plastic scintillator, continuous measurement of HTO$_v$ down to the MPC$_a$ level (10 pCi cm^{-3}) is possible with a response time constant of a few minutes, even with 1 nCi cm^{-3} of noble gases in the sampled air. When a liquid scintillator is used as detector, the processing system becomes far more complicated but the sensitivity to tritium and discrimination against noble gases are improved by an order of magnitude. By using less than 15 cm^3 h^{-1} of liquid scintillator the running costs of the latter system are kept low. (auth)

56157 (BMBW-FBK–72-11) TIME STRUCTURE INVESTIGATIONS OF CURRENT PULSES FROM SILICON SEMICONDUCTOR DETECTORS. **Fretwurst, E.; Haken, N.; Lindstroem, G.; Mueller-Roos, J.; Oelert, W. (Hamburg Univ. (West Germany). I. Institut fuer Experimentalphysik). Aug 1972. 41p. (In German). Dep. NTIS (U. S. Sales Only).**

Current pulses from silicon semiconductor detectors were investigated by means of a sampling oscilloscope and an averaging technique with a time resolution of 3 nsec. Several detectors were bombarded with alpha-particles as well as protons. Theoretical calculations of the current pulse shapes were performed and compared with experimental results as function of geometry, detector voltage, and temperature. (auth)

56158 (BMBW-FBK–72-12) PHYSICAL AND TECHNICAL DETAILS ON MANUFACTURING MINIATURIZED SILICON SURFACE BARRIER DETECTORS FOR MEDICAL AND BIOLOGICAL USE. **Pfeiff, H.; Allwein, M.; Linhart, G.; Paugger, R. (Nucletron, Gesellschaft fuer Nucleonic und Electronic m.b.H., Munich (West Germany). Giessen Univ. (West Germany). Wilhelm-Conrad-Roentgen-Klinik). Aug 1972. 43p. (In German). Dep. NTIS (U. S. Sales Only).**

Miniaturized semiconductor detectors of the surface-barrier type consisting of silicon cylinders are described with all technical details. The physical properties are shown and examples for in-vivo-application are given. (auth)

56159 (CEA-CONF–1995) ACTIVATION NEUTRON DETECTOR RELIABLE AT HIGH TEMPERATURE (1200°C). **Leger, P.; Bouvard, P.; Genthon, J. P.; Labrousse, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 14 Feb 1972. 5p. (In French). (CONF-720213–1). Dep. NTIS (U. S. Sales Only).**

From thirty-first conference of the Euratom Dosimetry Group; Geestacht, West Germany (24 Feb 1972).

An activation neutron detector reliable to temperatures slightly above 1200°C is described. The principle consists in enclosing in an envelope of silicon the metallic sample which constitutes the detector proper. The enclosure procedure follows definite procedures. The technique is employed systematically at Saclay for integration of fast neutrons by the reaction ^{63}Cu(n,α)^{60}Co. The results thus obtained are presented. They confirm the validity of this detector for fluxes of long duration. (tr-auth)

56160 (CEA-CONF–2013) AUTOMATIC MONITORING OF A DRAINAGE SYSTEM BY IMMERSED BEACONS. Matutano, J.; Grivaud, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires); de Choudens, H.; Jeanne, G.; Logre, P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 12p. (In French). (CONF-710705–13). Dep. NTIS (U. S. Sales Only).

From International symposium on rapid methods for measuring radioactivity in the environment; Munich, Germany (5 Jul 1971).

The construction and operation of an automatic monitoring system using immersed probes for the control of the radioactivity of the drainage system of a nuclear installation are described. The detector is a GM counter with glass walls with thickness between 50 and 70 mg/cm^2 fixed on a water-tight support and protected by a thin water-tight envelope. Six-months' practical service with the system shows that, in spite of early faults which were corrected, the apparatus is quite satisfactory. The sensitivity was satisfactory and the probe was sturdy and only slightly contaminable. The electronics were reliable. (J.S.R.)

56161 (EUR–4810(Vol.2), pp 571-81) COMPARISON BETWEEN THE IONIZATION PRODUCED IN THE SENSITIVE VOLUME OF A DIELECTRIC-LIQUID IONIZATION CHAMBER AND THE ENERGY WHICH IS DEPOSITED THERE, CALCULATED BY THE MONTE CARLO METHOD, FOR THE CASE OF IRRADIATION BY MONOENERGETIC ELECTRONS AT 1.5 AND 1.9 MeV. Casanovas, Joseph; Patau, Jean Paul; Mathieu, Jacques; Blanc, Daniel (Univ., Toulouse). (In French).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The simulation of the transport of the electrons was carried out in a multilaminate medium by means of the following experimental setup: a film of trimethylpentane 0.9 mm in thickness arranged between two thin Be electrodes 0.3 mm in thickness and placed in a plexiglas phantom. The energy spectra of the electrons crossing the interfaces bounding the sensitive volume were determined, and the total energy deposited there was deduced from them. For the purpose of verifying the validity of these calculations, the theoretical values for the energy deposited were compared with those from ionization, produced by the radiation in the sensitive volume, determined experimentally. This comparison was done for two electron energies, 1.5 and 1.9 MeV, at several depths in the plexiglas. (5 figures, 2 tables) (tr-auth)

56162 (EUR–4810(Vol.2), pp 601-17) SOME COMMENTS ON THE OPERATION OF PROPORTIONAL COUNTERS. Campion, P. J. (National Physical Lab., Teddington, Eng.).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

A semi-empirical equation for the gas gain in proportional counters is discussed with particular reference to the operation of such devices at very low pressures. The constants in this equation have been experimentally determined for tissue-equivalent gas. Although the equation is not strictly valid for the low pressures often used in microdosimetry it provides an adequate qualitative description of the gas gain in this region. In particular it is shown that one of the functions of the helix, in conjunction with the potential applied to the latter, in a Rossi-type proportional counter is to provide a discontinuity in the electric field strength. This enables such counters to be operated as spectrometers at considerably lower pressures than in conventional counters of comparable size. A simple difference technique for still further reducing the operating pressure by an order of magnitude is discussed. (auth)

56163 (EUR–4810(Vol.2), pp 645-55) EXPERIENCE WITH A WALL-LESS COUNTER. **Wilson, K. S. J.; Emery, E. W. (Hammersmith Hospital, London).**

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The design, setting-up, and calibration of a cylindrical wall-less counter and a geometrically similar walled cylindrical counter are described. Spectra are presented from α-particle and cyclotron neutron irradiations of both counters, and comparisons are made. (auth)

56164 (GULF-GA-A–12170) DETERMINATION OF NEUTRON FLUX AND NEUTRON FLUENCE FROM THE SIGNAL CURRENT OF A SELF-POWERED RHODIUM DETECTOR. **Hudritsch, W. W. (Gulf General Atomic Co., San Diego, Calif.). Jul 1972. Contract AT(04-3)-167. 18p. Dep. NTIS.**

Self-powered neutron detectors are suitable for continuous flux measurements and were used to monitor some of Gulf General Atomic's irradiation experiments in the Engineering Test Reactor in connection with the development of fuel for high-temperature gas-cooled reactors. The special case of a rhodium detector is analyzed, and explicit solutions for the neutron flux and neutron fluence as functions of the signal current of the detector are developed. (auth)

56165 (HSPH/EHS-70-2) RADIATION FROM NATURAL SOURCES IN THE URBAN ENVIRONMENT. Yeates, Donovan B.; Goldin, Abraham S.; Moeller, Dade W. (Harvard School of Public Health, Boston, Mass.). May 1970. 81p.

Procedures for the measurement of radiation exposures in the urban environment were developed and applied in a pilot survey. Measurements included assessments of indoor and outdoor exposures including those arising from cosmic radiation and those due to naturally occurring radionuclides. Measurements of cosmic and gamma radiation were made with a 16-liter muscle-equivalent chamber, a 16-liter freon-filled chamber, and a 3 × 3 NaI(Tl) crystal. Concentrations of individual nuclides in the radon decay chain were determined by alpha spectrometry combined with measurements of radioactive decay. These measurements were correlated with ventilation rates. Observed exposures outdoors ranged from 10 to 14 μR/hr, with cosmic radiation constituting about 4.4 μR/hr of these totals. Radiation levels on the first floor of wooden dwellings ranged from 9 to 12 μR/hr. Observed levels in concrete basements ranged from 10 to 12 μR/hr. The lower exposures indoors versus outdoors confirms previous work in the United States and Europe. Exposures in brick apartment buildings ranged from 10 to 12 μR/hr. Radon daughter concentrations outdoors varied from 0.01 to 0.15 pCi/l (^{218}Po). Concentrations in dwellings were about the same but concentrations in basements were substantially higher, ranging from 0.1 to 0.9 pCi/l. Radon daughter concentrations in air-conditioned office buildings were quite low, ranging from 0.02 to 0.07 pCi/l. A bibliography including an extensive review of published papers on previous studies of radiation exposures from natural sources is included. (auth)

56166 (JINR-P13-6578) SURFACE BARRIER DETECTORS OF p-TYPE SILICON. Kushniruk, V. F.; Nikitina, R. A.; Kharitonov, Yu. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

Surface-barrier detectors were fabricated from p-type silicon according to a method developed in the laboratory of Nuclear Reactions (OIYaI) which affords great simplicity and a stable product. Electrical and spectrometric characteristics are presented. An energy resolution of 19 keV for α particles with energies of 5.5 MeV and 14 keV for electrons with energies of from 60 to 650 keV was achieved. (tr-auth)

56167 (JINR-P13-6602) MULTI-SECTIONED PROPORTIONAL CHAMBER FOR THE INVESTIGATION OF (n,α) REACTIONS. Balabanov, N. P.; Popov, Yu. P.; Rodionov, K. G.; Semenov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

A multi-sectioned proportional chamber is described, consisting of a system of plane, duplex multiwire proportional counters, operating in a coincidence arrangement. The total area of the targets was 13,000 cm^2. The inherent background of the chamber was 0.0005 ± 0.001 imp/min · cm^2, fixed by the level of the natural α activity of the target backing and the wire electrodes. The chamber was designed for investigating infrequent reactions emitting charged particles and can operate in high γ fields. (tr-auth)

56168 (NIRS-Pu-7, pp 34-7) LARGE AREA PROPORTIONAL COUNTER FOR ASSESSMENT OF PLUTONIUM LUNG BURDEN. Tomitani, Takehiro; Tanaka, Eiichi (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

The apparent pulse shape difference between soft x ray and background was recognized by oscillographic observation. On this basis, pulses of soft x rays can be discriminated from those of background by means of the usual zero-cross pick-off method. Favorable results were achieved by use of electric circuits which adopt Esaki diode as zero-crosser, simple time gate technique, instead of conventional combination of time-to-pulse height converter and single-channel pulse height analyzer, and stretcher—linear gate combination, in contrast to the conventional combination of linear delay circuit and linear gate. By use of P. S. D. background counts can be reduced to about one-tenth of those without P. S. D. Further background reduction has been achieved by anti-coincidence techniques, in addition to P. S. D. Former model of lung monitor exhibits rather large gas leakage and large outgassing, which is attributed to structure of lung monitor. With these shortcomings in mind, another lung monitor was so designed that gas leakage and out-gassing could be reduced as far as possible; it uses a hermetic seal in place of rubber gasket, and rubber surface exposed to the interior of the counter is reduced as far as possible. A new counter has been constructed and operates satisfactorily, and even as an enclosed-type counter can operate more than one day. Prolonged evacuation may result in less out-gassing, and the counter may operate still longer. (auth) (Japan)

56169 (NIRS-Pu-7, pp 64-9) WHOLE-BODY AUTORADIOGRAPHIC SAMPLE MEASURING APPARATUS. Noda, Yutaka; Matsuoka, Osamu (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

Special measuring apparatus for the activity in vivo of whole-body autoradiography was developed. The detector system designed was a combination-type proportional counter—plastic scintillation detector, for the sake of low-background counting. The electronic circuit was prepared to process the pulse so that the output pulse of both detectors was amplified and pulse analyzed with or without coincidence. α and β particles (50 keV to 3 MeV) were measured independently and/or simultaneously. Background count rates were 0.031 cpm for α particles and 7.62 cpm for β particles (50 keV to 3 MeV). The pulse spectra obtained from the measurement of the various specimens were displayed. (auth) (Japan)

56170 (NIRS-Pu-7, pp 73-4) STUDY ON ROUTINE OPERATION FOR PLUTONIUM AIR MONITOR. Kikkawa, Motoyuki; Yoshikawa, Kikuo; Sumita, Hiromu (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

With respect to air contamination dosimetry for ^{239}Pu in an alpha emitter laboratory, problems such as performance and practical usage in the development of unique plutonium air monitoring systems were studied. An additional safety device on automatic warning dose level indicator is described which should take care of routine operations under most safety controls by the health physics section. It should be possible to set the critical dose levels at 8 MPC-hr for one room and 5 MPC-hr for five rooms, according to ability of air conditioning systems in the laboratory. (auth) (Japan)

56171 (NIRS-Pu-7, pp 79-80) TEST OF CHARACTERISTICS OF THE Pu WOUND MONITOR. Hongo, Shozo; Suzuki, Masashi; Tanaka, Eiichi (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

A detection system for Pu in wounds for practical use by which α particles and x rays can be measured with the same detector was reported previously. Final adjustment of the detection efficiency was accomplished, and resulted in the same detection efficiency for α and x-ray measurements. By using an 11-nCi Pu source, α particles and x rays were simultaneously measured by the detection system; and the deviation in estimation of the amount of contamination of Pu inside of the skin was obtained for a skin model of surface contamination of Pu, which has actually no contamination inside. With the efficiency obtained it would be possible to use the system as a Pu wound monitor for the selection of surface and in-wound contamination. (auth) (Japan)

56172 (SGAE-2018) OPTIMIZATION OF AN AIR MONITOR FOR RADIOACTIVE AEROSOL. Pusch, W. M. (Oesterreichische Studiengellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Strahlenschutz). May 1972. 27p. (In German). Dep. NTIS (U. S. Sales Only).

In an air monitor for radioactive aerosols, the activity deposited on the filter was measured continuously with a counter during the vacuuming of the filters. The pulse rate indicated by a delay rate meter at a sudden increase of the specific activity concentration of the air is standardized not directly to the theoretical value but lags behind it. It oscillates according to the law of statistics around a mean value. In order to know the lowest possible increase of the concentration of the specific activity air as soon as possible after its occurrence, the rate meter should react as rapidly as possible, which requires a small time constant of the monitor. On the other hand the oscillation of the mean value should be as small as possible (an increase of the counting should be known as such), in which a large time constant appears desirable. These two contradictory requirements for the size of the time constant must be optimized. (tr-auth)

56173 DETERMINATION OF INTRINSIC GAMMA-RAY DETECTION EFFICIENCIES FOR CYLINDRICAL GEIGER-MUELLER TUBES BY MONTE CARLO METHODS. Dunn, W. L.; Gardner, R. P. (North Carolina State Univ., Raleigh). Nucl. Instrum. Methods; 103: No. 2, 373-84(1972).

A Monte Carlo treatment for determining the efficiency of dual cathode material, metal-wall G—M tubes for detecting gamma radiation is developed and compared with experimental data. A monoenergetic, parallel, uniform beam of gamma rays incident perpendicular to the central wire is assumed. Only Compton scattering and photoelectric interactions are considered, and direct interactions with the filling gas are ignored. Various variance reduction techniques are incorporated. Although the treatment simplifies the details of electron motion and an exact treatment of electron direction from photoelectric interactions at photon energies of interest is not available for inclusion, comparisons of predictions with experimental data for four representative cases indicate quite acceptable accuracy. Calculation time is about 80 s for a range of six gamma-ray energies for any G–M tube. (auth)

56174 PRODUCT FOR NEUTRONOGRAPHY. Audran, Roger Gaston Louis; Renard, Guy Jean Alfred (to Kodak-Pathe). French Patent 2,092,830. 28 Jan 1972. Filed 23 Jun 1970. (In French).

A product for neutron radiography is presented. This product may be used for recording and counting tracks produced in solid media by the secondary emission of ionizing α particles resulting from the conversion of a neutron flux. This product consists of an inert, transparent, and uncolored polyester substrate provided with a substratum. The recording layer is made from colored cellulose nitrate. The product is also provided with an intermediate layer composed of a water-soluble hydrophile bonding material and a conversion layer consisting of a borate dispersed in lithium in a water-soluble bonding material. (France)

56175 PHYSICAL METHODS OF CHEMISTRY. PART IIID. Weissberger, Arnold; Rossiter, Bryant W. (eds.). Techniques of Chemistry. Volume I. New York; John Wiley and Sons, Inc. (1972). 716p.

Separate abstracts were prepared for 6 of the 10 chapters included. The remaining four chapters are outside the scope of NSA. (J.W.R.)

For abstracts of individual chapters see: 55662, 56176, 56233, 56234, 57536, and 57931.

56176 MEASUREMENT OF RADIOACTIVITY. Clark, Herbert M. (Rensselaer Polytechnic Inst., Troy, N. Y.). pp 587-659 of Physical Methods of Chemistry. Pt. IIID. /Weissberger, Arnold (ed.). New York; John Wiley and Sons, Inc. (1972).

Topics include radioactive decay, interactions of nuclear radiation with matter, self-decomposition of labeled compounds, radiological safety, nuclear radiation detectors, nuclear radiation measurement systems, measurement of alpha activity, measurement of beta activity, measurement of gamma activity, errors in radioactivity measurements, efficiency calibration of instruments and standardization of radionuclides, and low-level counting. (208 references.) (W.H.K.)

56177 TIMING SYSTEM FOR Ge(Li) DETECTORS. Gabriel, F.; Koepernik, H.; Schoeps, K. (Zentralinstitut fuer Kernforschung, Dresden). Nucl. Instrum. Methods; 103: No. 3, 501-2(1972).

A timing system for Ge(Li)-detectors is described. The timing system consists of a fast preamplifier, a fast linear amplifier and a zero crossing discriminator. The operation of the different devices is explained in block diagrams. The results of some characteristic physical measurements are shown. (auth)

56178 ROLE OF TARGET GEOMETRY IN 14 MeV NEUTRON CAPTURE CROSS-SECTION MEASUREMENTS. Valkonen, M.; Kantele, J. (Univ. of Jyvaeskylae, Finland). Nucl. Instrum. Methods; 103: No. 3, 549-53(1972).

Some activation capture cross sections of 14.5 MeV neutrons have been measured by systematically varying the target geometry. In all cases, the results are found to strongly depend on the geometrical conditions, which implies that a large part of the activation capture cross sections reported earlier are in error. An investigation of a number of materials shows that aluminum gives rise to a fairly small fraction of secondary low-energy neutrons and is, therefore, suitable material for target holders. A thin air-cooled target head specially designed for reliable activation cross-section measurements has been constructed and tested. (auth)

56179 CRITERION FOR THE SOLID ANGLE OPTIMIZATION IN THE ANGULAR CORRELATION MEASUREMENTS. Honzatko, J.; Kajfosz, J. (Inst. of Nuclear Physics, Rez). Nucl. Instrum. Methods; 103: No. 3, 617-18(1972).

The influence of multiple cascades on correct interpretation of γ–γ-correlation measurements is discussed. A criterion applicable in a geometrical arrangement is suggested. (auth)

56180 DETERMINATION OF THE QUALITY OF AN X-RAY BEAM IN THE 90 TO 160 kV RANGE WITH IONIZATION CHAMBERS HAVING WALLS COMPOSED OF DIFFERENT MATERIALS. Guille, B.; Decossas, J. L.; Bernard, M.; Dutreix, J. (Univ., Limoges, France). Ann. Phys. Biol. Med.; 6: No. 2, 87-98 (1972). (In French).

The nature of the secondary electron flux resulting from photon–matter interactions in materials depends upon the spectral characteristics of the incident radiation. The value of the accelerating potential and the characteristics of the filtration are used to determine the characteristics of the x-ray beam. The degree of ionization in an air-filled cavity in different media was determined uniquely using previously cited data. (France)

56181 EMPLOYMENT OF RADIOMETRIC METHODS IN INDUSTRIAL MEASURING TECHNIQUE. 1. FUNDAMENTALS. Polly, P. (Krohne KG, Duisburg, Ger.). Arch. Tech. Messen; 434: 55-8(1972). (In German).

As an introduction, a brief review is given on radioactivity and its properties (decay, absorption) and on detection methods (detectors, electronic counting circuits). (8 figures) (GF)

56182 METHOD FOR CONTROLLING THE SURFACE PROPERTIES OF Ge(Li) DETECTORS. Akinshin, B. K.; Pakhomov, E. E.; Pakhomova, A. L.; Polytsya, O. P. Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 3, 55-7(1972). (In Russian).

Methodics are described for evaluating the surface state of Ge(Li) γ-radiation detectors. Equipment is employed in which the measurements of the contact potential difference and the blanking voltage distribution over the p-i-n structure surface are combined. A simple pre-amplifier is used with a field-effect transistor at the input. Input impedance of the measuring circuit is $6 \times 10^{14}\ \Omega$, the error of the contact potential difference and of the blanking voltage distribution measurements is 3–5% and 1%, respectively. Possible applications of the methodics are discussed. (auth)

56183 DISPLAY QUOTIENT AND A DISPLAY NUMBER FOR RADIOGRAPHIC EVALUATION OF FILMS AND RADIATION QUALITY. Spangenberg, Harry D. Jr.; Pool, M. L. (Ohio State Univ., Columbus). Oral Surg., Oral Med., Oral Pathol.; 34: No. 2, 335-47(Aug 1972).

This evaluation of dental radiographic films compares the information obtained by use of the "average gradient," a display quotient, and a display number. The display quotient and the display number were found to be superior to the "average gradient" in distinguishing films and a wide variety of radiation qualities. The film and radiation quality which yields the largest value for the display quotient should be used when visualization is required for structures having a range of physical surface densities between 0 and 15 mm of aluminum. (6 figures, 7 tables) (auth)

56184 NEEDLE TYPE SOLID STATE DETECTORS FOR IN VIVO MEASUREMENT OF TRACER ACTIVITY. Lauber, A.; Wolgast, M. (Aktiebolaget Atomenergi, Studsvik, Sweden). Phys. Med. Biol.; 17: No. 4, 525-37(Jul 1972).

The construction and properties of a set of miniature detector probes for in vivo measurement of β- and γ-tracer activity are described. The probes used a lithium-compensated p–i–n silicon detector as sensing element. The basic needle probe contained a cylindrical detector 0.9 mm in diameter and 3 mm long, enclosed in a stainless steel tube 1.1 mm in outer diameter and with walls 0.05 mm thick. For particular applications several modified types were developed: probes with larger sensing elements, probes with extra thin walls for low-energy β-detection, probes with two or three sensing elements in the same needle and probes containing a movable sensing element. (auth)

56185 SOME ASPECTS OF THE USE OF SMALL NEEDLE-SHAPED SEMICONDUCTOR DETECTORS IN THE DETERMINATION OF REGIONAL DISTRIBUTION AND TRANSPORT OF LABELLED COMPOUNDS. Wolgast, M.; Lauber, A. Phys. Med. Biol.; 17: No. 4, 538-47(Jul 1972).

A study was made of some of the parameters of the indicator dilution curves obtained from β-sensitive needle semiconductor detectors, with particular reference to internal monitoring. It is pointed out that the size of the monitored volume will be determined by the surface area of the detector and the energy of the β-emitting isotope used. The number of counts recorded after a slug injection will be proportional to the amount of mother substance located in the monitored volume, the largest fraction being generated in the regions in the vicinity of the detector surface. The peak activity will be a fairly valid index of the flow to the region studied if the distribution of transit times is less than twice the mean transit time. The accuracy of the analysis will be influenced by the area around the detector damaged by the insertion of the probe, particularly pronounced in the study of multicompartment systems with low-energy β-emitters. (auth)

56186 SOME PRACTICAL OBSERVATIONS ON LIQUID SCINTILLATION COUNTING. Rummerfield, P. S.; Goldman, I. H. (Univ. of California, La Jolla, San Diego). Int. J. Appl. Radiat. Isotop.; 23: No. 8, 353-60(Aug 1972).

An investigation was made to determine practicability of switching from 20-ml vials to the newer minivials for liquid scintillation counting. Potential for a surprisingly large saving, due to decreased volume of counting fluid required, was found. In the course of making a savings estimate cost comparisons were made for various sizes and kinds of cocktails and vials. This led to evaluations and inter-comparisons of other important physical characteristics of vials and counting fluids which are of interest to users of this counting system. The cost of a particular brand of 8-ml plastic pharmaceutical vials was less than half the cost of the minivials specifically designed for liquid scintillation counters. Wide-neck 20-ml vials were found to be suitable adaptors for the 8-ml vials and were about seven times less expensive than commercial adaptors. (auth)

56187 INTRINSIC RESOLUTION OF A GAMMA CAMERA SYSTEM. Svedberg, J. B. (Univ., Uppsala). Phys. Med. Biol.; 17: No. 4, 514-24(Jul 1972).

Theoretical simulation of the Anger gamma camera system on a digital computer was used to study the dependence of the intrinsic resolution on the stochastic nature of the photomultiplier pulse formation, as well as on some design parameters. A simple analytical model was found to give similar results on a relative basis. A substantial improvement in resolution is obtained by a proper choice of light-guide material and by introducing specular reflection at the crystal front surface. (auth)

56188 POSITRON MODE OF THE TOTAL ORGAN KINETIC IMAGING MONITOR: SYSTEM DESIGN AND APPLICATIONS. Monahan, W. G.; Beattie, J. W.; Laughlin, J. S. (Sloan-Kettering Inst. for Cancer Research, New York). Phys. Med. Biol.; 17: No. 4, 503-13(Jul 1972).

A report is made of the completion, operational characteristics and some applications of the positron mode of the Total Organ Kinetic Imaging Monitor (TOKIM). The TOKIM system consists of two Anger-type scintillation camera detectors operated in coincidence to obtain three-dimensional resolution for positron emitting radionuclides. An IBM 1800 computer was used for data acquisition and analysis. Several different types of display are available in this system, including alpha-numeric print-out, dot density and isomeric read-outs on a storage oscilloscope. The maximum coincidence input data rate for the TOKIM was limited by electronic pile-up to about 3000 cps. The spatial resolution depends on the distance of separation of the detectors, but for a practical case is 1.25 cm (FWHM) in lateral planes and 3.0 cm (FWHM) in axial planes for a point source measured in air. There was very little change in spatial resolution for sources in scattering media. (auth)

56189 DOSIMETRIC CHARACTERISTICS OF NONHOMOGENEOUS SILICON DETECTORS OPERATING ON A PULSE COUNT PROCESS. Petushkov, A. A.; Manchuk, V. A. Med. Radiol.; 16: No. 11, 52-5(Nov 1971). (In Russian).

Measurements were made of the sensitivity of AuSi and Si(Li) detectors for a pulse counting system per unit of exposed dose. The dependence of pulse count on the pulse detecting threshold was determined. Sensitivity determination by computation is discussed. (3 figures) (tr-auth)

56190 DIRECT INTERCOMPARISON OF TWO WHOLE-BODY MONITORS IN THE MEASUREMENT OF THE ABSORPTION OF AN ORAL DOSE OF VITAMIN B_{12} LABELLED WITH ^{57}Co AND ^{58}Co. Boddy, K.; King, P. C.; Henderson, J. T.; (and others) (Scottish Research Reactor Centre, East Kilbride, Eng.). Phys. Med. Biol.; 17: No. 3, 374-80(May 1972).

The Royal Infirmary Edinburgh whole-body monitor, consisting of 2 NaI detectors, and the MERLIN mobile whole-body counter (Scottish Reactor Centre, East Kilbride), with a single NaI detector, were used in this study. Their performance in estimating the absorption of an oral dose of cyanocobalamin labeled with ^{57}Co and ^{58}Co was compared directly. Measurements were made on the same subjects using both monitors: (a) on the day of administration, when the variation in the counting rate was similar for the monitors; and (b) seven days later when the percentage absorption was estimated. Good agreement was obtained. Factors influencing the accuracy of the measurements are compared and discussed. (auth)

56191 SCANNER STAND MORE ESPECIALLY FOR SCINTILLATION COUNTERS. Brown, Ian Keith; Graham, John Peter (to Whiteley Lang and Neill Ltd.). British Patent 1,278,587. 21 Jun 1972. Filed 8 Dec 1969.

A support and scanning stand for scintillation counters as used to investigate lung functions with the aid of radioactive gases is described. This apparatus can be traversed, preferably under power, at a predetermined speed and length of scan relative to a patient being examined; and the axis of scan can be varied to suit vertical, horizontal and inclined postures of the patient, and to suit patients having widely differing physical characteristics. (UK)

56192 IMPROVEMENTS IN OR RELATING TO A RADIATION DETECTOR COMPRISING A SEMICONDUCTOR DEVICE. (to N. V. Philips Gloeilampenfabrieken). British Patent 1,278,444. 21 Jun 1972. Filed 23 Jun 1969.

Disadvantages of previously employed encapsulated semiconductor devices are first stated. The radiation detector described comprises an evacuated hermetically sealed container housing a radiation sensitive semiconductor device, such as Li-compensated Ge or Si, maintained during operation at a low temperature by a cryostat. A thermally conductive support plate is provided for the semiconductor device, and means are provided for improving the vacuum. A flexible thermal conductor is connected at one end to the support plate and arranged to traverse the container wall via a thermally insulated vacuum-tight passage, the other end of the conductor terminating in a connection engaging the cooling region of a cryostat. The support plate is itself supported by a tubular member arranged to surround the thermal conductor and to be thermally and electrically insulated from the container walls. Should a defect occur in the device, it is not necessary to completely demount it. Furthermore it is possible to carry out tests on the device when mounted on a cryostat or even on a simple Dewar vessel prior to final mounting on a cryostat, without the need for mounting it inside a complete cryogenic assembly. It is also unnecessary to outgas the device prior to mounting, and the device can be tested and adjusted from outside the cryostat. Means for improving and maintaining the vacuum may take the form of a filament of Ti or other refractory metal that can be evaporated, and electronic components associated with the device can be included in the container. (UK)

56193 RADIATION DETECTOR. Warren, H. D. (to Babcock and Wilcox Co.). Canadian Patent 902,273. 6 Jun 1972.

A radiation detector is described which can be used for in-core monitoring of localized neutron flux, gamma radiation, or both. The detector has an emitter, a collector, and an insulator interposed between the emitter and collector. The emitter material can be either ytterbium or hafnium. When the emitter is bombarded concurrently by neutrons and gamma rays, it emits prompt electrons proportional to the neutron and gamma flux intensities, and delayed electrons proportional to the neutron flux intensity. Since the prompt electrons have a higher energy than the delayed electrons, it is possible to mask the delayed electron component of the collector output current through the choice of insulator. The collector output current signal will then be constituted substantially entirely by the prompt electrons and will follow instantaneously (for practical purposes) variations in neutron flux and/or gamma intensity. (Canada)

56194 MEMORIAL IONIZATION CHAMBERS: CONSTRUCTION AND RESPONSE. Antoku, S.; Russell, W. J.; Mizuno, M.; Suga, Y. (Atomic Bomb Casualty Commission, Hiroshima). Health Phys.; 23: No. 4, 559-63(Oct 1972).

Ionization chambers of the type originally developed by Garrett and Laughlin at Sloan—Kettering Institute of the Memorial Sloan—Kettering Institute for Cancer Research, New York City, were manufactured at the Atomic Bomb Casualty Commission (ABCC), Hiroshima. These chambers, machined from air-equivalent material, and similar ones molded and machined at Sloan—Kettering Institute were assessed for various characteristics. Twenty-three of the chambers machined at ABCC were tested for leakage and initial charge voltage stability; and 21 of these with relativity uniform sensitivity were tested for energy and directional dependence. The machined chambers of Memorial Center and of ABCC had nearly the same characteristics. Those molded at Memorial Center were less stable according to initial charge voltages, but their other characteristics were similar to those machined at Memorial Center and at ABCC. (auth)

56195 SIMPLE, CONVENIENT INTERGRATOR FOR CHART RECORDERS OF RADIOACTIVITY. Lloyd-Jones, C. P. (Long Ashton Research Station, Bristol, Eng.). Chem. Ind. (London); No. 17, 680-1(2 Sep 1972).

A chart recorder integrator is described that overcomes the disadvantages associated with the types of integrator normally employed. It consists of a batch counter fitted with a 6V dc relay drive output coupled to a marker pen fitted to the chart recorder. The amplified counts from the detector are taken via two outputs, one to a rate meter and the other to the batch counter. The counts are accumulated by the batch counter until a pre-set number is reached. The count marker pen is then activated, the batch counter resets, and the cycle recommences. The intervals between marks on the chart thus indicate the periods during which the present number of counts occurred. The integrator will continue to give the total counts for the detector head even if the ratemeter or chart recorder is overloaded. The integrator has been in use for the determination of ^{14}C in eluates from an amino acid analyser, using an anthracene flow cell mounted on a photomultiplier as detector. (UK)

56196 CHANGES OF PARTICLE TRACK PARAMETERS IN NUCLEAR EMULSIONS OWING TO THE INFLUENCE OF ELECTRIC FIELD. Akopova, A. B.; Kartuzhanskii, A. L.; Magradze, N. V.; Melkumyan, L. V. Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 6, 508-11(1971). (In Russian).

A decrease in the length of a particle track was obtained simultaneously with an increase of the angle of entry of the tracks in a nuclear emulsion for electric fields of 1.5 to $6.0 \cdot 10^4$ v/cm. (auth)

56197 NEW METHOD OF ANALYZING RADIATIONS FROM GEOLOGICAL FORMATIONS. Pelet, Regis; Douzon, Jean (to Institut Francais du Petrole, des Carburants et Lubrifiants). French Patent 2,091,848. 21 Jan 1972. Filed 30 Oct 1969. (In French).

The method of analyzing γ radiation at a distance, described in the principal patent, is applied to analyzing γ radiations emitted by geological formations in view of establishing geological maps of an underwater bed: the detector device is moved in a specified manner over the surface of these formations. At the measurement station, the height of each pulse received (corresponding to each pulse received by the detector) is established as a function of the coordinates of the detector. A map corresponding to the γ ray emission of this bed is thus established. The detectors are dragged along the bed by a cable dropped from a boat. (France)

56198 DIRECTIONAL PROBE FOR MEASURING THE RADIOACTIVITY OF THE SOIL IN A DRILLING. Deyer, Gerard; Rancon, Daniel (to Commissariat a l'Energie Atomique). French Patent 2,096,696. 25 Feb 1972. Filed 12 Jun 1970. (In French).

A probe for measuring the radioactivity of the soil in a drilling is described. It consists of 5 small Geiger—Mueller counters with the appropriate cathode resistors systematically distributed in relation to the axis of the probe, a cylindrical collimator that surrounds these counters, a preamplifier, and a metallic envelope protecting the assembly. (France)

56199 OPTIMIZATION OF A WHOLE-BODY RADIATION COUNTER WITH EIGHT DETECTORS. Burkinshaw, L.; Marshall, D. H.; Oldroyd, B.; Oxby, C. B. (Univ. of Leeds, Eng.). pp 165-78 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The Leeds whole-body radiation counter is made up of eight NaI(Tl) scintillation detectors with crystals 15 cm in diameter and 10 cm thick. The detectors are mounted with their axes vertical, four above and four below a horizontal couch. The lower crystals move only in the horizontal plane, but the upper ones can also be adjusted vertically. Pulses from the detectors are passed to a 4096-channel pulse-height analyzer, where the eight outputs may either be stored separately or combined to give a single spectrum. A PDP-8/L computer is connected to the analyzer to perform calculations on the stored data. In many applications, it is important that the response of the counter should be as nearly as possible independent of the distribution of activity in the body. Several arrangements of the detectors have been tested, to find the one which most nearly achieves this objective. With each arrangement, a small radioactive source was placed successively at each of 31 positions in a water phantom. At each source position, the combined spectrum of the eight detectors was stored. The computer was then used to sum the counts in every possible energy band in each spectrum, to discover in which band the counting rate varied least between the 31 spectra. Results for γ-ray energies from 364 keV to 1.52 MeV were compared. The best arrangement was found to be one in which four detectors are placed at the corners of a square with their axes in a plane orthogonal to the long axis of the subject. In use, the eight detectors form two parallel squares, separated by half the length of the subject, and they scan the subject in a series of steps. The accuracy of measurement with various detector geometries, including the relative importance of counting statistics when low activities are measured is discussed. The effect of covering the curved surfaces of the crystals with open-ended, cylindrical lead shields is also considered. (auth)

56200 SEMI-EMPIRICAL EVALUATION OF THE PERFORMANCE OF A LINEAR SCANNER. Unnikrishnan, K.; Cottrall, M. F. (Inst. of Cancer Research and Royal Marsden Hospital, Sutton, Eng.). pp 179-85 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

In order to choose the optimum conditions for a linear scanner before setting it up in routine use for whole-body counting, calculations of the calibration factors have been performed by making certain assumptions regarding the attenuation in the body and the variation in geometry. The "build-up" concept has been included to extend the range of application of these calculations and to eliminate the need to use "effective values" for the absorption coefficients. Computer programs were developed for predicting (1) the count profile for a point source embedded in the phantom, (2) the total counts expected for a complete scan and (3) the total counts due to the scanning of a volume source. Basic data required for these were obtained empirically for ^{51}Cr using the photopeak, and typical predictions were verified experimentally. These procedures for evaluating the performance of the scanner under various conditions may be extended to other radionuclides by using any desired region of the spectrum. (auth)

56201 COMPUTER DATA PROCESSING FOR A WHOLE-BODY COUNTER. Feher, I.; Andrasi, A. (Central Research Inst. for Physics, Budapest). pp 187-99 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The whole-body counter, which was installed in 1964 at the Central Research Institute for Physics, Budapest, has been used for numerous experiments concerning the determination of occupational, incidental body burdens and for the measurement of the ^{137}Cs burden in the population. Initially, a manual procedure was used for the evaluation of the gamma spectra from the photopeaks. This method proved to be inaccurate and time-consuming. It was particularly difficult in cases where the overall error in a spectrum with several components had to be estimated and where a low-intensity contribution had to be distinguished from a high-intensity line next to it. Therefore, as soon as the problem of spectrum stabilization had been solved, a method was developed for the computer processing of whole-body counter data. The main features of a spectrum stabilizer operating with a reference light source and a system adopted for the transfer, storage and computer-processing of the data are described. The performance of the system is illustrated with reference to some test problems and the sources of error are discussed. Finally, the results obtained by computer processing of the measurements of occupational radiation burdens and of the ^{137}Cs burden in the population of Budapest are presented. (auth)

56202 CALIBRATION OF WHOLE-BODY COUNTING EQUIPMENT BY USING COMPUTERS INSTEAD OF PHANTOMS. Julius, H. W.; Verhoef, C. W. (Radiological Service Unit TNO, Arnhem, Netherlands). pp 201-13 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The calibration of whole-body counting equipment with various detector geometries by means of phantoms which simulate subjects of different shapes, weights, etc., is cumbersome and time-consuming. Consequently, it is not always possible to carry out a thorough calibration for cases requiring a special configuration. A mathematical approach seemed more promising than an empirical calibration so a computer program based on a three-dimensional model of the desired phantom and detector configuration was developed. In this program the experimentally found detector efficiencies have been used as a function of radiation energy, angle of incidence on the crystal and source distance. Though the program was primarily intended for homogeneous distribution of the activity in the phantom it also permits the calculation of the response to a hot spot or an active organ. The computer results have been verified experimentally for some simple cases and were found to be satisfactory. Details of the mathematics used and of the computer program are given, and some special results are discussed. (auth)

56203 QUANTITATIVE PROFILE SCANNING: USE OF A MATHEMATICAL METHOD FOR EXTRACTING THE MAXIMUM LIKELIHOOD ACTIVITY PROFILE, WITH ERROR ESTIMATES, SUBJECT TO THE EXCLUSION OF NEGATIVE ACTIVITIES. Parr, R. M.; Dudley, R. A.; Fedorov, G. A. (International Atomic Energy Agency, Vienna). Contract AT(30-1)-2819.

pp 215-32 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Profile scanning along the length of the body provides one method of obtaining information on the linear distribution of a gamma-ray emitting nuclide in a person. Procedures under development in the laboratory of the IAEA make use of a scanning-geometry whole-body counter, with the addition of a slit collimator in front of the 20-cm-diam. × 10-cm NaI(Tl) crystal. A profile scan is made along the subject's body in such a way that the counts in the energy band of interest are recorded over twenty consecutive segments, each of 9.4 cm length. Matrix methods of analysis are then applied to the data. First, a system of 20 simultaneous equations relating the mean count rates recorded over each of the 20 segments to the unknown activities in each of these segments is solved, using coefficients obtained by scanning over a phantom containing a standardized point source. This mathematically exact solution may distort the real picture (particularly when the total activity is low) by ascribing negative activities to some of the segments, and in compensation, exaggerated positive values to others. Therefore the exact solution is then modified by an iterative process, whereby the least-squares solution is found subject to the constraint that no segment may be assigned negative activity. Finally, to obtain estimates of the statistical errors of the results, a Monte Carlo approach is adopted in which artificial profile scanning data, based on the experimental data, are generated, and a new set of activities is calculated. This process is repeated 10 or more times, and the statistical errors are then estimated from the population of results. Experience with these procedures has shown that the exclusion of negative values from the solution leads to a major improvement in the usefulness of the results. The computational procedure is judged to extract nearly the maximum possible amount of information from the profile of recorded count-rates, and to lay an objective basis for comparing the performance of alternative measurement procedures. (auth)

56204 TESTING SOLID-STATE TRACK DETECTORS WITH A VIEW TO THEIR USE IN RADIOTOXICOLOGICAL LABORATORIES. Jeanmaire, L.; Ballada, J. (CEN, Fontenay-aux-Roses, France). pp 267-81 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Tests carried out to see whether solid-state track detectors can be considered as useful new laboratory tools are described. The tests were carried out with a detector sensitive to fissions (Makrofol) and another one sensitive to alpha radiation (cellulose nitrate). The fission detector would appear suitable for analyzing traces of uranium and the cellulose nitrate detector extremely useful for all alpha emitters. Both types of detectors seem likely to be useful for tissue autoradiography. (auth)

56205 ROLE OF SCINTIGRAPHY IN WHOLE-BODY COUNTING. Chomicki, O. A. (Bielanski Hospital, Warsaw). pp 447-55 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

A review is given of the parallel development of clinical whole-body counting and scintigraphy, the latter having followed the exponential law. The present trend seems to be for whole-body counting to incorporate to a much greater extent the localized measurements and, therefore, overlap the whole-body rectilinear scanning methods. At the same time, new high-sensitivity commercial scanners can be used as whole-body counters because of the use of large 5-in.-diam. × 3-in.-thick NaI(Tl) crystals. By adding inexpensive shielding (a collimator or a low-background room), activities of the order of nanocuries can be measured. The method of a low-cost whole-body scanner-type installation seems to be particularly appropriate in places where the high cost of whole-body counters prevents them from being used on a larger scale. (auth)

56206 WORKING REGION OF SCANNERS. Sorenson, J. A. (Univ. of Wisconsin, Madison). Phys. Med. Biol.; 17: No. 1, 101-3(Jan 1972).

Data are presented of count-rate versus collimator-source distance, in air, for a scintillation camera with a 6.4 cm thick collimator and 3 extended ^{99m}Tc sources. The near plane was defined by a distance from the collimator face equal to the collimator thickness. The ^{99m}Tc sources were 5-cm dia. and 2.5-cm dia. discs and a 1 cm × 0.5 cm syringe. Only the smallest source showed significant variations within the near plane, and these were considerably less than predicted by the inverse-square law based on source-detector distance as discussed by Sharma (Phys. Med. Biol., 16, 257, (1971)). It was concluded that (1) quantitative measurements of radioactivity in vivo could be assumed to be distance independent in air, within the near plane of the collimator, and (2) there is little point in moving a patient beyond the near plane of the collimator, as sources of dimensions smaller than the collimator aperture diameter do not occur with significant frequency. (UK)

56207 WORKING REGION OF SCANNERS. Sharma, R. R. (Inst. of Medical Education and Research, Chandigarh, India). Phys. Med. Biol.; 17: No. 1, 103-5(Jan 1972).

Reply is made to criticisms by Sorenson (Phys. Med. Biol., v.17, 1, p. 101-103 (Jan 1972)) of a previous paper on the working region of a scintillation scanner. It is assumed that for points within the near plane, the system behaves as an assembly of unrelated distant detectors. Sensitivity is discussed in terms of the inverse square law and collimator design. (UK)

56208 DETERMINATION OF CONCENTRATION OF RADON DAUGHTERS BY MULTI-DETECTOR SYSTEM. Kurosawa, Ryuhei (Waseda Univ., Tokyo). Waseda Daigaku Rikogaku Kenkyusho Hokoku; No. 52, 21-31(Jun 1971). (In Japanese).

The combination type (multi-detector system) instrument has been investigated to provide the accurate determination for the concentration of airborne radon daughters in a uranium mine. To achieve a high accuracy, the instrument employed a combination of a surface barrier type semiconductor detector (SSD) and GM tube. The airborne radon daughters in an atmosphere were collected by the millipore DA or HA filter at a flow rate of about 10 l/min for 1 or 3 min. The alpha and beta particles of the collected radon daughters were counted by the SSD and GM tube detector in the vacuum vessel. The detecting window of the SSD and the GM tube were placed close to the surface of the filter to reach a high sensitivity. To distinguish between the alpha particle of ^{218}Po and that of ^{214}Po, the output of the SSD was connected to the multi-channel pulse height analyzer or two sets of discriminators. The counting efficiencies of the detectors were determined by the variation of alpha or beta activity of the collected radon daughters with the elapsed time. The applicable equations for the determination of the radon daughter concentrations were found to be (sampling time: 3 min.; counting time: from 3 to 6 min of the end of sampling). $C_a = 1.96548 \times 10^{-6} I'_a \times 1/v_s$, $C_b = (-1.2486\ I'_a + 0.61242\ I_b - 0.80867\ I'_c) \times 10^{-6} \times 1/v_s$, and $C_c = (0.004785\ I'_a - 0.13206\ I_b + 0.81908\ I'_c) \times 10^{-6} \times 1/v_s$ where C_a, C_b, and C_c = concentration of ^{218}Po, ^{214}Pb, and ^{214}Bi in an atmosphere. (μCi/cm^3). I'_a = alpha counts of SSD, in the energy range 4.7 to 6.5 MeV. I_b = gross counts of GM tube detector. I'_c = alpha counts of SSD, at energies >6.5 MeV. v_s = flow rate of sampling, in cm^3/min. An accuracy better than 10% is obtained by this method. (auth) (Japan)

56209 IONIZATION CHAMBER FOR MEASURING THE ACTIVITY OF RADIOACTIVE SOURCES. Guiho, Jean Paul (to Commissariat a l'Energie Atomique). French Patent 2,087,162. 31 Dec 1971. Filed 6 May 1970. (In French).

A parallel electrode ionization chamber for measuring the activity of solid or liquid sources (γ active or weakly α or β active) is presented. The first planar electrode is connected to the ht supply, the second electrode is composed of separated concentric rings, which may be interconnected by brushes, and are located in a plane parallel to that of the first electrode. A source holder, the position of which can be adjusted in the central orifice, enables the source under observation to be raised up from its original position in the plane of the second electrode. (France)

56210 DETECTION OF ALPHA PARTICLES BY THIN TRIAFOL TN FOIL. Spurny, Frantisek (Lab. for Radiological Dosimetry, Prague). Jad. Energ.; 18: No. 9, 315(Sep 1972).

The detection efficiency of Triafol TN (cellulose triacetate) track detectors for alpha particles was studied. A standard ^{241}Am source was used at various source-to-detector distances. Foils were etched by 10 N NaOH at 60°C. Results are tabulated. (W.H.K.)

56211 EFFECTS OF POLYMER DEGRADATION ON PLASTIC SCINTILLATORS. Weir, N. A. (Lakehead Univ., Thunder Bay, Ont.). Int. J. Appl. Radiat. Isotop.; 23: No. 8, 371-9(Aug 1972).

The fluorescence yields and counting efficiencies of polyvinyltoluene-based plastic scintillators are decreased as a result of their irradiation with ultra-violet light, both short (λ = 2537 Å) and long wave (λ > 3000 Å) in air. Although coloration of the polymer and scintillant decomposition occur, their combined effects are insufficient to account for the results. It appears that photo- and photo-oxidative degradation of the polymer, with the associated cross-linking and oxygenated product formation, alter the course of fluorescent radiation production principally by modifying energy transfer processes between the polymer and the primary solute. The consequences of scintillator degradation brought about by exposure to sunlight and oxygen are discussed. (auth)

56212 IMPROVEMENTS IN OR RELATING TO TRITIUM (HTO) MONITOR. Perry, Kenneth Edward Gordon (to United Kingdom Atomic Energy Authority). British Patent 1,281,403. 12 Jul 1972. Filed 24 Apr 1969.

The monitor described comprises an open circuit through which the air is passed, a closed circuit through which water is circulated, a bubble sampler allowing air in the open circuit to bubble through the water circulating in the closed circuit, and a radiometric device responsive to radioactivity in the water. The radiometric device includes a scintillation material responsive to radiation emitted by tritiated water, with a transducer coupled to receive light from the scintillation material. The transducer is shielded against external radiation, and may consist of a photomultiplier tube maintained at a constant low temperature. Means are provided for filtering the water before it contacts the scintillation material. (UK)

Radiation Dosimeters

Refer also to abstracts 56404, 56496, 56521–56523, 57878–57880, 57890, and 57895.

56213 (COO–1500–21) RADIATION MONITORING OF URANIUM MINERS: A COMPARISON OF BIOASSAY, TLD, AND THE KUSNETZ DETERMINATIONS OF CURRENT EXPOSURES. Schiager, Keith J.; Savignac, Noel F. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). May 1972. Contract AT(11-1)-1500. 247p. Dep. NTIS.

Comparisons were made of three methods for determining current exposures of uranium miners to inhaled, short-lived radon progeny. The first method was that presently used by uranium mining companies, i.e., spot sampling of work areas by the Kusnetz method combined with exposure-time estimates. Personal air sampling with TLD monitors, and bioassay via long-lived radon progeny in whiskers, were the other two methods used in the comparison. Based upon sixteen months of monitoring of 40 miners and 10 control subjects, it was concluded that at the present state of development, neither the personal air sampling nor the bioassay monitoring system was superior to the method now used by mining companies. The TLD air sampling system suffered from numerous mechanical problems, although the TLD detector unit performed properly. The bioassay method produced poor correlations with the other methods, apparently as a result of large variations in the contributions of Ra D sources other than the inhaled, short-lived radon progeny. These other sources of Ra D are discussed in detail. (auth)

56214 (EGG–1183–2267) DOPED POLY(HALO)STYRENE DOSIMETER MATERIAL STUDIES. Humpherys, K. C.; Randtke, P. T. (EG and G, Inc., Santa Barbara, Calif.). Sep 1971. Contract AT(29-1)-1183. 59p. Dep. NTIS.

For Sandia Corp., Albuquerque, N. Mex.

The accomplishments of a program to fabricate and characterize various formulations of doped poly-(halostyrene) dosimeter films developed by the Sandia Laboratory are summarized. Specifically, films of 4-chlorostyrene and 4-bromostyrene doped with malachite green methoxide were fabricated and studied. Fabrication techniques are described, and results are presented for experimental studies of stability, calibration, and the effects of temperature and various gas environments on the dosimetric properties of the films. Also included are the results of characterization studies performed on doped poly(halo)styrene dosimeter films fabricated by the Sandia Laboratory for use in the Diesel Train Event. (auth)

56215 (EUR–4810(Vol.2), pp 619–31) MODIFICATION OF THE ROSSI COUNTER FOR MEASUREMENT OF RADIATION QUALITY. Srdoc, D. (Institut Rudjer Boskovic, Zagreb).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

A tissue-equivalent proportional counter suitable for field measurements has been developed and tested. The counter consists of a small cylinder made of tissue-equivalent plastic enclosed in a thin aluminum tube. The counter is filled with a tissue-equivalent gas mixture. Calibration of the proportional counter is performed with an external source of soft x rays via a thin window. Extensive testing has shown that counter characteristics remain relatively constant over a 6-month testing period. (auth)

56216 (EUR–4810(Vol.2), pp 633–44) DEVELOPMENT OF A MICRODOSIMETRY SYSTEM FOR USE WITH HIGH ENERGY ELECTRON BEAMS. Lindborg, Lennart (Inst. of Radiation Physics, Stockholm); Bengtsson, L. Gunnar.

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

A microdosimetry system based on the use of tissue equivalent proportional chambers has been developed. In the gas filling system, the gas flows through needle valves in the high and low pressure ends. This ensures a good short-term stability of the gas pressure. A spherical 10 mm chamber has been built. Two tissue equivalent wall materials differing strongly in carbon and oxygen contents are available. Special precautions have been taken to make the chamber work for direct current measurements besides the conventional pulse measurements. Stainless steel central wires have been used having diameters 25 and 13 μm. The suspension system for one end of the wire is completely contained within the 3 mm chamber wall resulting in a compact chamber assembly. The position of the wire has been checked using a diagnostic x-ray image. Preliminary results concerning gas gain and pulse height analysis are presented. Future plans will include attempts at making microdosimetry measurements in betatron electron beams. (auth)

56217 (EUR–4810(Vol.2), pp 657–74) TWIN VOLUME APPARATUS FOR MICRODOSIMETRIC STUDIES. Burlin, T. E.; Benstock, D. M. J.; Haddow, L. M. (Polytechnic of Central London).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Some radiobiological data indicate that damage by ionizing radiations must occur in two sites before observable changes occur. In order to study the energy deposition by ionizing radiations in two volumes an apparatus consisting of twin proportional counters has been designed and constructed. The proportional counters are "wall-less". The distance between them and their orientation with respect to the source may be varied. The sensitive volume of the counter is determined by the relative potentials on the anode wire, the eight cathode wires and gas chamber walls. The appropriate potentials for different separation of the counters has been found by extensive field plotting. Preliminary results are presented. (auth)

56218 (EUR–4810(Vol.2), pp 675–95) RECENT ADVANCES IN TSEE DOSIMETRY AND ITS POTENTIALS IN MICRODOSIMETRY. Becker, Klaus; Gammage, R. B.; Crase, K. W.; Cheka, J. S. (Oak Ridge National Lab., Tenn.).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

A brief summary of recent TSEE research and development at ORNL is given. A silicon-activated, heat-sensitized and properly stabilized ceramic BeO turned out to be most promising for practical applications. The response to radiation of varying LET (gamma, low-energy beta, alpha radiation, and fast-neutron induced recoil protons) has been studied in the 10^{-4} to 10^{-5} rad range. Substantial progress has been made to optimize sensitivity, stability, and reproducibility of response, and to simplify the readout procedure. The potentials of such detectors in "solid-state microdosimetry" are briefly discussed. (auth)

56219 CONVERSION OF AN INTRACAVITARY SCINTILLATION COUNTING SYSTEM TO A DOSE-RATE METER. Tetenes, P. J.; Schulz, R. J. (Albert Einstein Coll., Bronx, N. Y.). Phys. Med. Biol.; 17: No. 3, 425-8(May 1972).

A integrator circuit is described which allows a Nuclear-Chicago D58-1 surgical scintillation probe, designed for intracavitary measurements, to be used as a dosemeter. The CsI scintillator supplied with the probe is changed to a tin-loaded, air-equivalent plastic one with absorption properties similar to those of soft tissue. The integrator circuit is introduced between the detector and the ratemeter and, as currently used, the 10K counts/min scale of the ratemeter corresponds to 100 rads/hr at the detector. Dose rates as small as 1 rad/hr may be measured, and the instrument background is zero for all practical purposes. (UK)

56220 RESPONSE OF THE SILICON AVALANCHE DETECTOR IN BETA, GAMMA, X-RAY, AND NEUTRON DOSIMETRY. Moldofsky, P. J.; Gelezunas, V. L. (General Electric Co., Philadelphia). Phys. Med. Biol.; 17: No. 3, 381-9(May 1972).

The responses of several silicon avalanche detectors and tunnel diode preamplifiers to exposures of known γ- and x-ray dose rates were measured over the energy range 34 keV to 1.33 MeV. Curves of detector isodose response and efficiency as a function of energy are presented, with a discussion of operating voltage effects. A preliminary detection efficiency is determined for exposures to 16.9-MeV neutrons, and response as a function of dose is found for the β-spectrum of ^{147}Pm (maximum energy = 230 keV). In all measurements, the tunnel diode preamplifier was used, providing very fast and low noise amplification. The measurements demonstrated dosimetry capabilities of the avalanche detector—tunnel diode preamplifier over a wide range of energies and dose rates, and sensitivity to β-, γ-, and x-rays and to neutrons in a single detector. (auth)

56221 HEAT DEFECT IN CARBON CALORIMETERS FOR RADIATION DOSIMETRY. Bewley, D. K.; Page, B. C. (Hammersmith Hospital, London). Phys. Med. Biol.; 17: No. 4, 584-5(Jul 1972).

A carbon calorimeter was exposed to 7-MV x rays on 4 occasions, the last 2 being preceded by conditioning doses of 7-MeV electrons given the day before. It was concluded that radiochemical reactions with absorbed O_2 in a carbon calorimeter result in additional liberation of heat amounting to 2 ± 2% of that deposited by the radiation. Pre-irradiation by 0.5 Mrad eliminated the effect. (UK)

56222 COMPARISON OF IONIZATION AND FERROUS SULPHATE DOSIMETRY FOR MEGAVOLTAGE ELECTRONS. Law, J.; Naylor, G. P. (Univ. of Edinburgh). Phys. Med. Biol.; 17: No. 3, 400-8(May 1972).

For ^{60}Co γ-radiation and electrons of incident energies from 3 to 35 MeV, dose measurements using ionization and $FeSO_4$ methods are compared. Factors given by the Hospital Physicists Association (HPA) "Practical guide to electron dosimetry" were used, and results from the two methods did not differ by more than 4%. However, the ionization results based on the HPA values of C_E gave a mean G-value of 15.2 over this energy region. If it were assumed that photon beams producing primary electrons of a given mean energy have the same G-value as electrons of that energy, then electron G-values predicted from photon results using HPA C_λ values and the same $FeSO_4$ equipment were about 8% higher than experimental values for 6- to 10-MeV electrons. (auth)

56223 USE OF BaF_2 THERMOLUMINESCENCE IN DETERMINING RADIATION QUALITY. Dixon, R. L.; Watts, F. C. (Wake Forest Univ., Winston-Salem, N. C.). Phys. Med. Biol.; 17: No. 1, 81-7(Jan 1972).

The thermoluminescence of high-purity BaF_2 crystals was studied. The thermoluminescent light output/R as a function of photon energy was measured over the range 30 keV to 1.25 MeV and agreed reasonably well with a calculation based on the assumption that the light output depends only on the energy absorbed in the crystal. The K-edge of Ba was also observable in the thermoluminescent response of BaF_2. Due to the extremely rapid variation of light output/R with photon energy in the range of 80 to 600 keV, it was possible to determine the half-value layer of an orthovoltage x-ray unit used in therapy with a single exposure of the BaF_2 crystal to an accuracy of ±5%. (auth)

56224 HEAT DEFECT IN TISSUE-EQUIVALENT RADIATION CALORIMETERS. Bewley, D. K. (Hammersmith Hospital, London); McCullough, E. C.; Page, B. C.; Sakata, S.; Cyclotron, M. R. C. Phys. Med. Biol.; 17: No. 1, 95-6(Jan 1972).

A calorimeter made out of tissue equivalent plastic was exposed to 7 MV x-rays. There was an excess production of heat (~10%). It was suggested that the plastic contained dissolved O_2 which would react with the plastic during irradiation to produce additional heat. A calorimeter given a pre-irradiation dose of 0.1.Mrad measured 95.8 erg g^{-1} rad^{-1} the following day, compared with 108.9 erg g^{-1} rad^{-1} indicated by a Farmer–Baldwin ionization chamber. A further conditioning dose of 1.0 Mrad gave a measurement after 24 hr of 94.4 erg g^{-1} rad^{-1}. The standard error was ~1%, with absolute values in error up to 2% due to uncertain calibration of the ionization chamber. A brief note is made to the effect that measurements with a fast neutron beam (7.5 MeV) showed no change in calorimeter response to fast neutrons following pre-irradiation. (UK)

56225 EFFECT OF LIGHT EXPOSURE ON THE OPTICAL DENSITY OF IRRADIATED CLEAR POLYMETHYLMETHACRYLATE. Chadwick, K. H. (EURATOM–ITAL, Wageningen, Netherlands). Phys. Med. Biol.; 17: No. 1, 88-93(Jan 1972).

A study was made of the effect of light on the radiation induced absorption band of clear polymethylmethacrylate used as a radiation dosemeter in the 100 krad to 10 Mrad range. Photoluminescent emission spectra are presented of samples irradiated with 2 Mrad of 1.5 MeV electrons at 20°C and –160°C, together with the effect of light (250 to 400 nm) on the optical density (OD) spectra. It was concluded that the photosensitivity found in irradiated polymethylmethacrylate could be ascribed to the development of a species having a strong optical absorption in the 300 nm region and the development of a species absorbing in the 265 nm region. The effect was dependent on dose and light spectrum and simple corrections were not possible. (UK)

56226 PARTICLE SIZE AND SUPRALINEARITY IN LiF. Zanelli, G. D. (General Infirmary, Leeds, Eng.). Phys. Med. Biol.; 17: No. 1, 99-101(Jan 1972).

Three particle size fractions ($d > 100$ μm, $d \sim 4$ μm, $d < 1.0$ μm) of LiF-7 powders were irradiated in a 10,000 Ci ^{60}Co irradiation facility. The dose range was ~6×10^2 to 2.5×10^6 rads (in LiF). The LiF was read out 24 h after exposure, and the dose rates at the places occupied by the gelatine capsules containing the powder were determined by Fe_2So_4 dosimetry. The results showed that the supralinear dose-response of LiF-7 was independent of particle size. (UK)

56227 ELECTRON DOSIMETRY. Gamble, J. M.; Peake, J. C. F. (St. Luke's Hospital, Guildford, Eng.). Phys. Med. Biol.; 17: No. 1, 97-8(Jan 1972).

Four × 0.6 cm^3 Farmer–Baldwin chambers were compared at energies from 10 to 35 MeV in 5 MeV steps, using an electron beam from a Brown Boveri 35 MeV betatron. Strontium-90 checks were made on all instruments before and after each session and intercomparisons were repeated over a period of 3 months, with the exception of the 24 MeV set. The results are tabulated as the ratios of the sensitivities of chambers at all energies relative to their ratios at 10 MeV. There was a slight tendency for the Tufnol walled chambers to become relatively more sensitive than those with nylon walls. (UK)

56228 AN ALBEDO-TYPE PERSONNEL NEUTRON DOSIMETER. Hoy, J. E. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Health Phys.; 23: No. 3, 385-9(Sep 1972).

A modified thermoluminescent neutron dosimeter (TLND) is described and compared with film-type neutron dosimeters, over which it shows substantial improvement. The size and weight are acceptable when attached to a belt, and the directional sensitivity is almost identical to the directional dependence of nuclear emulsion film. The lower limit of sensitivity (dependent on the TLD material and the magnitude of the associated gamma exposure) for the material tested (^7LiF and ^6LiF) gave 5 mrem ±4% at 1σ as detectable with minimum gamma interference, and 10 mrem ±160% at 1σ in the presence of 1000 mR of gamma radiation from radium. The highest dose equivalent (DE) measured under controlled conditions was 46,000 rem with the result being lower than the estimated DE by 10%. No rate dependence greater than +20% was observed for DE rates up to 7×10^7 rem/sec, and one technician using one reader processed approximately 90 badges per day manually. It is concluded that this dosimeter, although showing substantial improvement over the film type, has limitations in certain energy regions of the spectrum. At installations where neutron sources are contained or sufficient scatter is present, the dosimeter provides a reasonably accurate method of integrating personnel exposures from unknown spectra. (UK)

56229 HIGH LEVEL DOSIMETRY USING 0.8N HYDROCHLORIC ACID SOLUTIONS OF FERROUS ION. Nagayama. Hisashi; Ohno, Shin-ichi; Ohkubo, Takashi (Japan Atomic Energy Research Inst., Tokai). Radioisotopes (Tokyo) 21: No. 8, 478-81(Aug 1972). (In Japanese).

The radioinduced oxidation of ferrous ions in 0.8N hydrochloric acid solutions was investigated using a 45 kCi ^{60}Co γ source. It was found that the system is suitable for high-level dosimetry up to 40 Mrads. The reaction mechanism, dose rate dependence, and temperature dependence of the radiolytic yield as well as the thermal stability of the system are also reported. (auth)

56230 THERMOLUMINESCENCE IN LITHIUM FLUORIDE: APPARENT ACTIVATION BY MANGANESE. Rossiter, M. J.; Rees-Evans, D. B.; Ellis, S. C. (National Physical Lab., Teddington, Eng.). J. Phys., D (London); 5: No. 6, 1164-7 (Jun 1972).

The possible use of manganese as co-activator in the thermoluminescent system LiF : Mg was investigated. The activators were added as fluorides during single-crystal growth by the Stockbarger–Bridgman method. Enhancement of thermoluminescence sensitivity was achieved with one sample of MnF_2, but it was shown that the agent responsible was titanium impurity in the MnF_2. (auth)

56231 PORTABLE MICROCALORIMETER FOR MEASUREMENT OF X RAY BEAM CHARACTERISTICS. Kovarik, J.; Kovar, Z. (Lab. of Radiation Dosimetry, Prague). Jad. Energ.; 18: No. 9, 298-301(Sep 1972). (In Russian).

The characteristics of x ray beams up to a maximum spectral energy of 400 keV were determined with a portable microcalorimeter. The results indicated that the device was capable of measuring energies as low as 10^4 erg/sec with an accuracy of 1%. The convenience in using the calorimeter stems from its small dimensions and low weight (6 kg). It may be utilized as a practical calibration instrument in x ray laboratories without special preparation. (tr-auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 55739.

56232 EXPERIMENTAL MEASUREMENTS OF THE RELATIVE PEAK EFFICIENCIES OF VARIOUS COMPTON POLAR-

IMETERS. Twin, P. J. (Univ. of Liverpool). Nucl. Instrum. Methods; 103: No. 3, 613-16(1972).

The relative total energy peak efficiencies of conventional γ-ray Compton polarimeters, constructed using both Ge(Li) and NaI(Tl) detectors, and a planar Ge(Li) polarimeter have been experimentally determined for a range of γ-ray energies from 0.66 MeV to 3.27 MeV. (auth)

56233 EXPERIMENTAL ASPECTS OF MOESSBAUER SPECTROSCOPY. Heber, Rolfe H. (Rutgers—The State Univ., New Brunswick, N. J.); Hazony, Yehonathan. pp 215-306 of Physical Methods of Chemistry. Pt. IIID. /Weissberger, Arnold (ed.). New York; John Wiley and Sons, Inc. (1972).

The theory, gamma sources, detectors and nuclear spectroscopy, spectrometers and drives, dewars and ovens, sample manipulation, data handling, and standards, calibrations, absorbers, and references are discussed. (226 references.) (W.H.K.)

56234 GAMMA-RAY SPECTROMETRY. Nielsen, Julian M. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. pp 661-87 of Physical Methods of Chemistry. Pt. IIID. /Weissberger, Arnold (ed.). New York; John Wiley and Sons, Inc. (1972).

Topics include the interactions of gamma rays with detectors, gamma ray detection systems, instrumentation, gamma ray spectra measurements, and coincidence techniques. (W.H.K.)

56235 ANTICOINCIDENCE-SHIELDED Ge(Li) GAMMA-RAY SPECTROMETER FOR MARINE ENVIRONMENTAL RADIONUCLIDE ANALYSIS. Michijima, Masami; Miyake, Hiroshi (Kobe Univ. of Mercantile Marine, Japan). J. Nucl. Sci. Technol. (Tokyo); 9: No. 8, 445-52(Aug 1972).

An anti-Compton γ-ray spectrometer has been developed, which possesses a number of characteristics particularly adapted to direct measurement of low-level complex mixtures of radionuclides in marine environmental samples. The detector assembly consists of a 42.7 cm^3 coaxial Ge(Li) detector and a well-type 6″ diam. × 4″ NaI(Tl) detector for the anticoincidence shield. The sample to be measured is placed on the Ge(Li) detector inside the well of the NaI(Tl) crystal. Suppression of the Compton background is particularly marked at the Compton edge when the assembly is operated in anticoincidence mode. The anticoincidence shield reduces the ^{137}Cs Compton edge by a factor of 6.6 to provide a peak-to-Compton edge ratio of 210 : 1 without reducing the full-energy peak efficiency by more than 2%. Similarly, for the 1,332.5 keV ^{60}Co γ-rays the Compton edge is reduced by a factor of 7 to give a peak-to-Compton ratio of 85 : 1, though in this case the peak efficiency is reduced by a factor of 1.8 due to the cascade decay. This spectrometer has permitted the detection of a few pCi of fallout niclides such as ^{137}Cs and ^{95}Zr, contained in 30 g environmental wet samples counted at intervals of 1,000 min. (auth)

56236 COUNTING RATE OF A THREE-AXIS SPECTROMETER. Kalus, J. (Univ., Munich). Z. Phys.; 254: No. 2, 148-61(1972).

A simple description for the calculation of the counting rate of a three-axis spectrometer is given. First- and second-order expansion gives simple expressions for the counting rate, the resolution, and the best choice of the parameters of the apparatus. (auth)

56237 METHOD OF STANDARD SPECTRUM FITTING FOR THE ANALYSIS OF GAMMA-RAY SPECTRA FROM SEMICONDUCTOR DETECTORS. Tasaka, Kanji (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 9: No. 7, 430-2(Jul 1972).

A method is described which makes use of a standard spectrum representing a single photopeak to serve as the shape function. The method expresses the line shape accurately and simply, requires only a small number of fitting parameters, and permits the analysis of several overlapping peaks by adjusting the width of the standard spectrum through the method of least squares. The fitting function and the method of setting the initial values of the fitting parameters, the principal problems encountered in the analysis of γ-ray spectra, are discussed. It is concluded that complicated gamma spectra with multiple photopeaks can be fitted accurately to a composite curve made up of superimposed peaks modeled on a standard spectrum and combined with the linear background continuum by using the least-squares method. The procedure described can also be applied to the fitting of spectra that cannot be expressed by an analytical function. (2 figures) (R.W.R.)

56238 VERSATILE INTERCONNECTION OF FOUR SPECTROMETERS TO A PDP-11 COMPUTER. Lefebvre, Y.; Axmann, A. (Institut Max von Laue—Paul Langevin, Grenoble, France). CAMAC Bull.; No. 4, 9-11(Jul 1972).

Data Acquisition and Processing over long distances generate great problems, which can be solved by using an extension of the PDP-11 UNIBUS. The new BUS, consisting of 100 balanced lines, may have any length. A unit called a SYSTEM CONTROLLER takes the place of both the usual SYSTEM CONTROLLER and CRATE CONTROLLER. The primary interfacing of four spectrometers is done using CAMAC modules and crates. (EURATOM)

56239 NUCLEAR SPECTROMETRY. Servent, J. M. (Societe d'Applications Industrielles de la Physique, Malakoff, France). CAMAC Bull.; No. 4, 15-16, Jul 1972).

To illustrate some interesting features of using CAMAC with an on-line computer, SAIP-SCHLUMBERGER has developed an experimental system for nuclear spectrometry. This system and its software are not the most sophisticated, and many other improvements can be provided, but they fill the main function encountered in the nuclear spectrometry field. (EURATOM)

56240 BENT CRYSTAL GAMMA SPECTROMETER USED FOR THE STUDY OF $1f_{7/2}$ NUCLEI. Van Assche, P. H. M. (SCK/CEN, Mol, Belgium). pp 245-7 of Structure of $1f_{7/2}$ Nuclei. Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

56241 LIGHT EXTINCTION IN LIQUID SCINTILLATION COUNTING. Koch, F.; Tamas, St. Stud. Univ. Babes-Bolyai, Ser. Phys.; 17: No. 1, 65-70(1972). (In German).

The spectra of β radiation for the isotopes ^{3}H, ^{14}C, and ^{35}S were measured with the aid of liquid scintillators. The extinction for H_2O and D_2O were studied, and it was shown that the extinction was less for heavy water; the differences between these two extinctions was constant for ^{3}H and possessed a minimum for ^{14}C and ^{35}S. (3 figures, 1 table) (tr-auth)

56242 SYMMETRICAL TWO-CRYSTAL COMPTON POLARIMETER FOR GAMMA RAYS. Bass, R.; Brinkmann, Sigrid; von Charzewski, Cornelia; Hanle, H. (Univ., Frankfurt am Main). Nucl. Instrum. Methods; 104: No. 1, 33-43(1972).

The application of a symmetrical two-crystal arrangement to the measurement of gamma-ray linear polarization is described. Test measurements were made with two polarimeters, consisting of either NaI(Tl) or Ge(Li) detectors, and gamma rays of known polarization at energies between 0.2 and 4.4 MeV. The results are given and discussed. (10 figures, 3 tables) (auth)

56243 COMPTON SPECTROMETER CONSTRUCTED WITH Si(Li) AND Ge(Li) DETECTORS. Logan, B. A.; Jones, R. T.; Ljubicic, A. (Univ. of Ottawa). Nucl. Instrum. Methods; 104: No. 1, 55-9(1972).

A Compton spectrometer was constructed with Si(Li) and Ge(Li) detectors. The spectrometer is capable of giving a strong suppression of Compton events from high-energy gamma rays and allows weak, lower energy gamma rays to give clear peaks in complex spectra. (5 figures, 1 table) (auth)

56244 SPECTROMETER FOCAL PLANE DETECTOR FOR HEAVY IONS. Harvey, B. G.; Mahoney, J.; Puehlhofer, F. G.; (and others) (Univ. of California, Berkeley). Nucl. Instrum. Methods; 104: No. 1, 21-32(1972).

A resistive-wire position-sensitive proportional transmission counter was built for the detection of heavy ions in the focal plane of a magnetic spectrometer. The 45 × 6 cm^2 counter measures position and energy loss with a resolution of 0.7 mm and 8 to 10%, respectively. Time of flight is measured with a plastic scintillator behind the proportional counter. The position, time, and energy loss signals are used to identify heavy ions with unit mass and atomic number resolution up to about A = 20, Z = 10. (15 figures, 1 table) (auth)

High Energy Physics Instrumentation

Refer also to abstracts 56838 and 56848.

56245 (SLAC-152) SOLENOID VERTEX SPECTROMETER: A SIMULATION STUDY. Luste, George Juris (Stanford Linear Accelerator Center, Calif.). Jun 1972. Contract AT(04-3)-515. 63p. Dep. NTIS.

The particle detection characteristics of a large solenoid magnet and spark chamber system are examined by means of Monte Carlo simulation. Such a device would serve as a vertex spectrometer in a two magnet system. The nominal parameters are: a 25 kG axial field, a 2 meter diameter and a 3 meter length. The solenoid magnet can surround the target and measure the low momentum, large angle particles and a second magnet downstream with a conventional gap and field would measure the fast secondaries. The axial field solenoid has ideal azimuthal symmetry and is well suited for rotating the transverse momentum vector of slow particles in hadron interactions. A detailed study of the acceptance, momentum resolution, and pattern recognition properties of the solenoid system is presented. The overall conclusions are that it can measure most particles of 2 GeV/c or less very well, improve overall acceptances dramatically, fill in dead regions of decay distributions, make high invariant mass studies feasible (8 to 16 GeV/c beams) and present no obvious difficulty for the pattern recognition of tracks. A fast track recognition algorithm is presented and no major computing needs are anticipated for the magnetic field inside the solenoid. (auth)

56246 RELATIVISTIC PARTICLE SEPARATION BY MEANS OF TRANSITION RADIATION UTILIZING MULTIWIRE PROPORTIONAL CHAMBERS. Yuan, L. C. L.; Uto, H.; Dell, G. F. Jr.; Alley, P. W. (Brookhaven National Lab., Upton, N. Y.). Phys. Lett.; 40B: No. 6, 689-92(21 Aug 1972).

Investigations were made on a transition radiation detection system consisting of a series of radiator—wire proportional chamber sandwiches and its feasibility for particle separation. A method for eliminating the "Landau" tail in the ionization distribution of a charged particle is described. (auth)

56247 POSSIBILITY OF MEASURING BEBC PICTURES WITH AN HPD. Selonke, F. (Univ., Bonn); Wurth, R.; Brockmann, H. H. Nucl. Instrum. Methods; 103: No. 3, 461-7(1972).

From investigations based on the measurement of pictures from the Argonne 12 foot bubble chamber, it is concluded that an HPD (Hough—Powell Device) with a conventional mercury arc (BH6) illumination system will very probably be suitable for the measurement of BEBC (Big European Bubble Chamber) pictures. (auth)

56248 OBSERVATIONS ON THE PERFORMANCE OF WIDE GAP SPARK CHAMBERS. Brenner, A. E.; Grossman, D.; Petersen, D.; (and others) (Harvard Univ., Cambridge, Mass.). Nucl. Instrum. Methods; 103: No. 3, 469-78(1972).

The performance of wide gap spark chambers was studied under experimental operating conditions. With care these chambers perform well as high spatial resolution detectors for multitrack events if all tracks are at angles less than about 20° relative to the electric field. When some tracks are at angles greater than 20° serious inefficiencies develop. Various techniques for minimizing these inefficiencies are discussed. (auth)

56249 COMPACT GAS CHERENKOV COUNTER WITH LARGE APERTURE. Bar-Yam, Z.; De Pagter, J.; Dowd, J.; Kern, W. (Southeastern Massachusetts Univ., North Dartmouth). Nucl. Instrum. Methods; 103: No. 3, 607-11(1972).

A threshold gas Cherenkov counter with an aperture of 26 cm and an overall length of 97 cm has been constructed. It is designed to distinguish pions from kaons and protons in the momentum range from 1.3 to 3.0 GeV/c. Its optical design allows the collection of Cherenkov light from the whole length of the counter, resulting in a detection efficiency of over 99% and a high rejection ratio for delta rays from below-threshold particles. Its short length and low pressure (<165 psi) effectively minimize multiple scattering of the detected particles. (auth)

56250 FIRST RESULTS OF TRIPLET PRODUCTION MEASUREMENTS NEAR THE THRESHOLD WITH A STREAMER CHAMBER TECHNIQUE. EXPERIMENTAL SET-UP. Roche, G.; Arnold, J.; Augerat, J.; (and others) (Univ., Clermont-Ferrand, France). Nucl. Instrum. Methods; 103: No. 3, 533-44(1972).

The experimental mounting is described. Characteristics concerning chiefly the gas constitution in the chamber, the streamer density in the tracks (number of streamers per cm) and the gap length distribution are given. It is shown that kinematical relationships allow very interesting criteria for triplet events. First results of the experimental study are indicated. (auth)

56251 APPLICATION OF A MULTICRATE CAMAC SYSTEM TO A PION ELECTROPRODUCTION EXPERIMENT (PEP). Clarke, D.; Collins, M. W.; Wardle, A. G. (Science Research Council, Daresbury, Eng.). CAMAC Bull.; No. 4, 12-15(Jul 1972).

Signals from a bank of photomultipliers are buffered in a NIM fast-logic system; and event data-buffers and other functions, interfaced via CAMAC to a Honeywell DDP-516 computer. The DDP-516 is connected via a CAMAC data-link interface and an IBM 1800 multiplexor to a large time-shared IBM 360/65 computer. Feedback of status information and the display of the results of current data analysis allow efficient control of the experiment to be exercised. (EURATOM)

56252 APPLICATION OF X-RAY TRANSITION RADIATION TO CHARGED PARTICLE DETECTION IN THE 300 GeV REGION. Bateman, J. E. (Univ. of Durham, Eng.). Nucl. Instrum. Methods; 103: No. 3, 565-74(1972).

The problem of utilizing the phenomenon of transition radiation for the detection of ultra-relativistic charged particles is analyzed. It is shown that a foam of liquid deuterium is likely to provide the best possible laminar medium for particles in the energy range accessible to the new high energy accelerators. A proposal is made for the deuterium bubblebath detector which will give useful resolution of the Lorentz factor (γ) in the range 500 to 10,000. Application of this device to particle discrimination in momentum analyzed beams is very promising. Rejection factors of greater than 100: 1 are predicted for pion—kaon separation in the region of 100 GeV/c. (auth)

56253 DEVICE FOR MEASURING THE COORDINATES OF POINTS BELONGING TO A SURFACE. Boulanger, Jean-Pierre; Lafontaine, Antoine; Pottier, Jacques (to Commissariat a l'Energie Atomique). French Patent 2,093,168. 28 Jan 1972. Filed 4 Jun 1970. (In French).

A device for measuring the coordinates of points belonging to a surface is presented. This device may be used in elementary particle physics to obtain information from bubble chamber photographs and in biology for photographic measurements. The device is provided with a movable view finder for locating a point on the surface; a luminous source emitting a light beam; a separator dividing the light beam into three secondary beams; three optical systems, each consisting of a semi-transparent mirror, a rotating mirror, and a fixed mirror reflecting one of the secondary beams into the optical system of the view finder; three photoelectric cells, each one being positioned along the common optic axis of the fixed mirror, the rotating mirror and the semi-transparent mirror; and electronic equipment for processing the signals emitted by the three cells. (France)

56254 DEVELOPMENT OF ULTRASONIC BUBBLE CHAMBERS. Brown, R. C. A.; Hilke, H. J. (European Organization for Nuclear Research, Geneva). Phys. Bull. (London); 23: 215-18(Apr 1972).

The principle of the ultrasonic bubble chamber (USBC) is described. The expansion phase of a sound wave in the bubble chamber liquid is used to expand the liquid below its sensitive limit, thus causing microbubbles to grow along the tracks of charged particles. Provided that the resulting bubbles reach a sufficient size at the end of the first expansion phase of the sound wave, the subsequent compression phase does not completely recondense the bubble, and under the influence of a variety of energy transport processes known as rectified diffusion and resonant absorption, the vapor bubble diameter continues to grow from cycle to cycle. A useful gain in pressure amplitude is obtained by using a standing wave system. Sensitivity is restricted to the pressure antinodes in the resonant cavity, of which only half (those in the expansion phase) will be sensitive to one particular ionizing particle. Tracks will thus appear segmented at intervals of one sonic wavelength in the bubble chamber liquid. This should not prove a serious restriction on resolution provided that the wavelength is kept relatively short, say 2 mm. This method of sensitization has several advantages in the context of a vertex chamber. Details are given of the USBC at CERN and the H_2 USBC at Dubna (USSR). (UK)

56255 TRIGGERED SPARK GAP WITH ROTATING ELECTRODES. Fulbright, H. W. (Univ. of Rochester, N. Y.). Nucl. Instrum. Methods; 104: No. 1, 71-2(1972).

A spark gap used for triggering a spark counter is described, featuring rotating Sparkonite electrodes. It operated for more than 10^8 firings without apparent deterioration of characteristics. (auth)

56256 INFLUENCE OF GATE TIME WIDTH ON THE MULTIPLE NEUTRON DISTRIBUTIONS OBSERVED IN THE NM64 COSMIC RAY NEUTRON MONITOR. Fujii, Zenjiro; Kodama, Masahiro; Wada, Masami (Inst. of Physical and Chemical Research, Saitama, Japan). Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 66: No. 1, 1-9(Mar 1972).

The influence of different gate time widths adopted in a multiplicity meter on the observed neutron multiplicity distribution has been investigated quantitatively with the Itabashi and Mt. Norikura NM64 neutron monitors. The validity of a simplified set of correction equations has been checked for several multiplicity distributions obtained from different geometries of monitors and different gate time intervals from 1 msec to 1.95 msec. It is shown that the overpassing as well as the overlapping effect is not negligibly small but gives considerable contribution to the observed multiplicity spectrum and the mean multiplicity for the gate time up to 1.5 msec. (auth) (Japan)

Radiometric Instruments

56257 THICKNESS MEASUREMENT OF VERY THIN COATINGS ON UPGRADED PAPERS, BOARDS, AND PLASTICS. Nitzl, K.; Grebe, W.; Koller, H. (Papiertechnische Stiftung fuer Forschung und Ausbildung in Papiererzeugung und -verarbeitung, Munich). Papier (Darmstadt); 26: No. 1, 11-17(1972). (In German).

A method is described which allows the thickness measurement of very thin layers on laminated and coated materials. The methods used are X-ray fluorescence as well as beta backscattering (^{14}C, ^{147}Pm). It is shown that this method is suited down to very small coating weights. (13 figures, 3 tables) (auth)

56258 IMPROVEMENTS TO PRESSURE IONIZATION GAGES USING RADIOACTIVE SUBSTANCES. Gitton, Bernard; Brunot, Alain (to Agence Nationale de Valorisation de la Recherche). French Patent 2,093,217. 28 Jan 1972. Filed 5 Jun 1970. (In French).

An ionization-type pressure gage is presented in which the ionization is produced by a radioactive substance. The cylindrical measurement volume contains two electrodes. One of the electrodes is covered with a radioactive β emitting substance (^{63}Ni); a second electrode is maintained at a certain potential with respect to the first electrode, an electric field thus being established between the two electrodes. In addition, a magnetic field is established in this volume by a permanent magnet; the purpose of this field is to increase the path of the radiation. In this way the performance of the gage is improved: the measurement range is extended towards very low pressures; the accuracy and operational reliability are increased. The ion current collected for pressures lying between 10^{-6} and 10^{3} mm of Hg is not less than 0.2 pico-amperes. (auth)

56259 INVESTIGATION OF THE γ-RAYS COMPONENT FROM THE RADIATIVE CAPTURE OF NEUTRONS IN THE SOIL, MEASURED BY HELP OF THE CADMIUM PROBE TYPE WO-65 DESIGNED FOR SOIL MOISTURE INVESTIGATION. Muras, Karol (Politechnika, Lodz, Poland). Nukleonika; 17: No. 1-2, 99-114(1972). (In Polish).

The intensity of γ rays from thermal-neutron capture in the soil, measured by means of the probe type WO-65, designed for soil moisture investigation, is examined. This probe is based on the combination of (n,n) and (n,γ) methods; and the (n,γ) component is so great that it mustn't be neglected, although that is often forgotten. With the help of theoretical calculations and empirical measurements the effect of moisture, kind and density of the soil, and the influence of the borehole on the γ component was investigated. It was demonstrated that, by moisture measurement using the probe WO-65, one ought to take the kind of soil and the kind of access tube into consideration; the latter also influences the effects of soil chemical composition on the probe indications. (7 figures, 2 tables) (auth)

56260 NUCLEAR WIRE THICKNESS MEASUREMENT. Neumann, J. Draht; 23: No. 1, 9-13(1972). (In German).

An industrial device is described that has been tested in practice and is to be used in fully automatic wire drawing for the measuring and control of wires made of various materials and with various diameters. The device consists of a point-shaped radiation source (e.g., ^{241}Am), a NaI-scintillator head, and the dectronic measuring device. It has been tested and officially approved and complies with the provisions of the Radiation Protection Ordinances. There is no need for the definition of a controlled area, or for the presence of a health physicist. (GF)

56261 DENSITY MEASURING BY GAMMA-RAY ABSORPTION. TION. Rozsa, Sandor. Energ. Atomtech.; 24: No. 11, 466-72 (Nov 1971). (In Hungarian).

The operation and industrial applications of gamma radiometric densimeters in Hungary are discussed. (W.H.K.)

Radiation Effects on Instrument Components, Instruments, and Electronic Systems

56262 (CEA-R-4323) THEORETICAL AND EXPERIMENTAL STUDY OF THE PRIMARY AND SECONDARY PHOTOCURRENTS PRODUCED BY γ-RAY PULSES IN BIPOLAR TRANSISTORS. Lecat, Xavier (Commissariat a l'Energie Atomique, Bruyeres-le-chatel (France). Centre d'Etudes). Jul 1972. 36p. (In French). Dep. NTIS (U.S. Sales Only).

A method for calculating the primary and secondary photocurrents produced by an ionizing radiation pulse in bipolar transistors is described. The purpose of the study was to obtain theoretical expressions for the two currents, which can be calculated from easily measurable physical and electrical constants or from the constructors data. Satisfactory agreement was observed between the experimentally measured values and those determined theoretically, the uncertainties in the measurements and the accuracy of the numerical calculation being taken into consideration. The numerical calculation which is very suitable for computerized treatment can be applied to any form of ionizing pulse. (France)

56263 (CEA-R-4324) STUDY OF THE BEHAVIOR OF NEUTRON AND γ IRRADIATED DOUBLE DIFFUSION TRANSISTORS USING THE IBIS MODEL. Burkhart, Andre; Mouton, Jacqueline (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Jun 1972. 59p. (In French) Dep. NTIS (U.S. Sales Only).

A brief description is given of the IBIS model (two-dimensional operation in the static region) used to study double diffusion transistors. The behavior of a neutron or γ ray irradiated bipolar transistor can be related to the variations in the parameters of its equivalent circuit as a function of dose. The effect of neutrons and γ or x radiation on the base and collector current components was verified experimentally. Calculations were developed in order to localize the radiation effects in the different active or passive zones of the transistor (degradation of the different parameters such as the base current components and the gain). The IBIS model was used. (France)

56264 DETERMINATION OF THE RECOMBINATION-CENTER PARAMETERS OF IRRADIATED p–n JUNCTION. Trilisskii, V. A.; Shostaks, P. B. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 3, 8-14(1972). (In Russian).

A technique for measuring the temperature dependence of the slope parameter of the current–voltage curve was developed. The slope parameter value was measured for base currents from 5×10^{-11} A. It is shown that the energy level of the recombination centers in irradiated silicon p–n junction lies close to the middle of the forbidden energy gap. (auth)

56265 A FOUR PARAMETERS MODEL THAT FITS THE DEGRADATION CURVE $\Delta V_G(V_G)$ OF MOS TRANSISTORS UNDER IRRADIATION. Buxo, J.; Esteve, D.; Enea, G.; Martinez, A. (Centre National de la Recherche Scientifique, Toulouse). Solid-State Electron.; 15: No. 9, 1029-31(Sep 1972).

The irradiation of MOS transistors causes a shift $\Delta V_G(V_G)$ of the transfer characteristics $I_D(V_G)$ due to a positive space charge buildup in the bulk of the oxide film. A phenomenological model was proposed by the authors in 1969 (Solid-St. Electron. 12, 123) in which the extent of the space charge region is determined by balancing the current injected from the cathode with the photo current flowing in the part of the oxide remaining neutral under irradiation. It is proposed to complete this model by a more physical approach of the degradation mechanisms in order to account for the two general features of the $\Delta V_G(V_G)$ curves: the $\Delta V_G(V_G)$ curve goes through a minimum for a negative value of V_G; ΔV_G exhibits a value different from zero, at this minimum. It is shown that the radiation-induced positive space charge buildup in the oxide can be interpreted as being due to the formation of an oxide surface barrier at each heterojunction of the MOS sandwich. A quantitative model containing four parameters, ψ, μ_n, N_t, and T^*, is presented that describes the behavior of these surface barriers. It allows fitting of the experimental degradation curve $\Delta V_G(V_G)$ of MOS transistors under ionizing radiation. Assumptions made in order to obtain this simplified four parameters model are discussed. (auth)

56266 FUNDAMENTALS OF NUCLEAR HARDENING OF ELECTRONIC EQUIPMENT. Ricketts, L. W. New York; John Wiley and Sons, Inc. (1972). 579p. $29.95.

A general discussion is presented on the nuclear hardening of electronic equipment to meet requirements of exposure dose rate of gamma radiation, integrated neutron flux density, and electromagnetic pulses. Chapters are included on radiation environment effects, radiation effects on electronic materials, radiation susceptibility of discrete devices, radiation effects on integrated circuits, circuit analysis, electromagnetic impulses, reliability, and future prospects. (J.R.D.)

Miscellaneous Instruments and Components

Refer also to abstracts 56035, 56985, 57007, and 58075.

56267 (ANCR–1074) INSTRUMENTATION AND CONTROL BRANCH ANNUAL REPORT, 1971. Smith, G. L. (comp.) (Aerojet Nuclear Co., Idaho Falls, Idaho). Aug 1972. Contract AT-(10-1)-1375. 90p. Dep. NTIS.

ADVANCED TEST REACTOR—instrumentation for, upgrade of N-16
    —power supply for, battery-backed
    —safety rod drop and release timer for
DATA ACQUISITION SYSTEMS—description of operational manifold for
    —development of SASSY
EDDY CURRENT TESTING—equipment for
ENGINEERING TEST REACTOR—protection system for, single failure analysis of

—data acquisition system for fuel clad oxide film experiment
INDUSTRIAL WASTE—monitoring of waste water well for hexavalent chromium
LEVEL INDICATORS—development of ultrasonic and conductivity-sensitive liquid, for LOFT corrosive water environment
PRESSURE GAGES—development of free field, for measuring PWR coolant pressure during blowdown
—performance testing for measuring LOFT coolant pressure during blowdown
REACTOR FUEL ELEMENTS—thickness measurements of plate type, ultrasonic piezoelectric crystal for in-pile
—cladding for plate type, ultrasonic detection of blistering of
—cladding for pin type, laser welding of metal-sheathed thermocouples to Zircaloy-4
REACTOR SAFETY EXPERIMENTS—instrumentation for LOFT, development of
THERMOCOUPLES—performance testing of titanium-sheathed, for measuring surface temperatures of PWR fuel pins, (W.H.K)

56268 (JINR-P10-6554) PROGRAM CONTROLLER IN THE STANDARD "CAMAC". Elizarov, O. I.; Zhukov, G. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1972. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

Equipment designed for the automation of physical experiments without the use of an electronic computer is described. A block diagram of the CAMAC is depicted, and the functioning of individual components is discussed. (tr-auth)

56269 (K-L-6299) COMPUTER CONTROL AND DATA PROCESSING FOR FIFTEEN ISOTOPE RATIO MASS SPECTROMETERS. Sulfridge, Clint (Oak Ridge Gaseous Diffusion Plant, Tenn.). 29 Sep 1972. Contract W-7405-eng-26. 16p. Dep. NTIS.

A small computer system has been interfaced to 15 uranium hexafluoride isotope ratio mass spectrometers which operate continuously. Performance of the system has been highly satisfactory since it was put in operation early in 1971, and has enabled more effective utilization of the spectrometers. The system includes a PDP-8/I computer with 8K core memory, a 32K disc, one digital ratiometer, an input teletype, and an output teletype. The system automatically times the analysis events for individual spectrometers, collects the analysis data, performs the necessary calculations, stores certain results, and prints all final results on the output teletype. (auth)

56270 (UCRL-51130(Vol.1)) FINAL REPORT ON THE DEVELOPMENT OF THE GEOGRAPHIC POSITION LOCATOR (GPL). VOLUME 1. SUMMARY. Salisbury, J. D. (California Univ., Livermore. Lawrence Livermore Lab.). 30 May 1972. Contract W-7405-Eng-48. 35p. Dep. NTIS.

The Geographic Position Locator (GPL) is a small, self-contained unaided system for accurate, long-term, land-based inertial navigation. It uses the normal rest periods of land-based systems to reduce system errors and improve the subsequent navigational accuracy. Operation can be fully automatic, with a motion-state sensor activating the error-reduction process during stationary periods. Stored map information for automatic comparison with computed position, and selective response based on the comparison, also could be part of a fully-automated GPL system. Possible use of the GPL with nuclear weapons was the primary motivation of the program. The techniques developed, however, apply to other navigation systems where the mission includes occasional stops and external references are unavailable. (auth)

56271 MEGAHPOL: A FAST ON-LINE NONCOMPUTER MULTIPARAMETER DATA REDUCTION SYSTEM. Maglich, B.; Sannes, F. (Rutgers-The State Univ, New Brunswick, N. J.). Nucl. Instrum. Methods; 103: No. 2, 245-8(1972).

Reasons for the elimination of on-line computers from experiments and their replacement with a faster "MEGAHPOL" (MEGA-event Hardware-Programmed On-Line) data reduction system are described. MEGAHPOL is capable of reducing data in multiparameter experiments involving readout of up to 100 scintillation counters at a rate of 100,000 events per second. Integrated circuit interface elements are wired according to a program determined by the physics objectives. The interface reduces the contents of the counters into one word, which is stored in a special purpose multichannel analyzer. At the end of each 30-min run the analyzer memory, containing typically 10^7 events binned in up to 4096 combinations, is dumped onto magnetic tape. (3 figures) (auth)

56272 CAMAC SYSTEM CONTROLLER. Meyer, J. M.; Perrin, M.; Mlynek, D.; Lehmann, M.; Metzger, G. (CRNS, Strasbourg, France). Nucl. Instrum. Methods; 103: No. 3, 601-6(1972). (In French).

A modular Camac System Controller with special features including programming units, data buffers and interfaces via branch highway and computer is described. This S.CTR is seen as a CAMAC processor which locally adapts the very different data handling and transfer speeds of the computer and the CAMAC branch. A brief description of the different components of the S.CTR is given. (auth)

56273 THREE-PARAMETER MAGNETIC TAPE DATA RECORDING SYSTEM. McClure, D. A.; Kendrick, N. S.; Lewis III, J. W. (Georgia Inst. of Tech., Atlanta). Nucl. Instrum. Methods; 103: No. 3, 453-60(1972).

A three-parameter coincidence data collection system has been constructed based on the use of computer compatible magnetic tape. The system was designed for use at the thermal neutron capture gamma-ray facility at the Georgia Institute of Technology Research Reactor. Up to three 12 bit words can be used to describe the coincidence event. The first two words consist of the output from two analog-to-digital converters (ADC) e.g., two 2048 channel energy spectra. The third word consists of the output of a 256 channel ADC e.g., time spectrum, plus four "status registers." The system is highly versatile and operates in the one-, two-, or three-parameter mode. The interfacing logic is based on the use of commercially available circuit boards. Each function of the logic can be tested via commands from a PDP-8 series computer although the device is completely independent of the computer when operating in the data acquisition mode. (auth)

56274 ABSTRACTS OF THE PAPERS TO BE PRESENTED AT THE 5th IMEKO CONGRESS, 25-30 MAY 1970, VERSAILLES, FRANCE. Budapest; IMEKO (1970). 305p. (CONF-700513-(Absts)).

The 173 abstracts presented are divided under the topics: industrial measurement technique for on-line computation; on stream composition analysis; new solid state devices in instrument design; advances in design, manufacture, and production control of instruments; new sensors, transducers and transmitters for in vivo biological measurements; advances in flow measurement for optimization of material balances; environmental problems of sensors and instruments; automatic inspection and testing; theory of measurement; novel standards for basic and derived units; and major achievements in measurement technique and application. An author index is included. (W.H.K.)

56275 OPERATION OF THE 1P28 PHOTO-MULTIPLIER AT HIGH CURRENTS. Ellison, D. H.; Wilkinson, F. (Univ. of Leeds, Eng.). Int. J. Radiat. Phys. Chem.; 4: No. 3, 389-91 (Aug 1972).

An alternative approach to that of Hunt et al. (Int. J. Radiat. Phys. Chem. 1972, 4: 87) is presented for operating the 1P28 photo-multiplier at (typically) 50 mA. (auth)

56276 RAY TRACING OF CHARGED-PARTICLE TRAJECTORIES IN A PRISMATIC UNIFORM-FIELD ASTIGMATIC SPECTROMETER. Bhattacharya, P. K. (High Altitude Research Lab., Gulmarg, India). Nuovo Cim.; 11B: No. 1, 167-79(11 Sep 1972).

An analytical ray-tracing method is discussed to describe the path of charged particles on the basis of simple mathematical concepts derived from the stereogeometry of the trajectories, obeying Barber's rule, within the uniform magnetic field of a prismatic spectrometer. Formulae accurate to first-order terms are computed to estimate image width, momentum spread, velocity dispersion and resolving power for particles emanated from a point source. The effect of the fringing field is also taken into account. (auth)

56277 ALARM DEVICE UTILIZING INFRARED EMISSION TO DETECT OVERHEATING. Jamet, Jean; Ponthus, Louis (to Commissariat a l'Energie Atomique). French Patent 2,093,399. 28 Jan 1972. Filed 12 Jun 1970.

A device, sensitive to the infrared radiation emitted by uranium slugs in a storage chamber, is presented. The device possesses an infrared detector provided with a filtered optical focusing system and an alarm system. (France)

56278 ADJUSTABLE GAS INLET SYSTEM FOR AN ISOTOPE MASS SPECTROMETER. Coleman, M. L.; Gray, J. (Univ. of Alberta, Edmonton). Rev. Sci. Instrum.; 43: No. 10, 1501-3 (Oct 1972).

A versatile gas inlet system has been devised that overcomes many of the difficulties associated with other methods. A metering valve has been inserted between one of the two capillaries and the source of an isotope mass spectrometer. Tests have shown that the valve not only controls flow rate but also determines the proportion of molecular to viscous flow, in such a way that the fractionating effects of the inlet systems are equalized regardless of the differences between their reservoir pressures. Some of the advantages are ease of balancing capillaries (allowing the use of glass) and elimination of bellows or mercury pistons, allowing baking of the whole inlet system. The device may be automatically controlled for continuous balancing of flow rates. (auth)

56279 BAKABLE CHANGEOVER VALVE FOR HIGH PRECISION MASS SPECTROMETRIC COMPARISON OF THE ISOTOPIC COMPOSITION OF GASES. Begbie, P. J.; Beckinsale, R. D.; Freeman, N. J.; Powell, R. E. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Rev. Sci. Instrum.; 43: No. 10, 1454-5(Oct 1972).

The construction of a bakable changeover valve for high precision mass spectrometric comparison of the isotopic composition of gases is described. The leakage across the valve seats is about an order of magnitude smaller than the values published for similar valves in use, and the ‘‘mixing correction’’ which can be a significant correction to the experimental data is negligible. (auth)

56280 MASS SPECTROMETER FOR RADIOLYSIS PROCESSES STUDIES. Wincel, Henryk; Kuczara, Roman; Grabowski, Krzysztof; Bargiel, Roman; Henrych, Ryszard (Inst. of Nuclear Research, Warsaw). Nukleonika; 17: No. 1-2, 87-97(1972).

The design of a mass spectrometer for studies of radiation-chemical processes and some test results are discussed. (11 figures, 1 table) (auth)

56281 SECTOR-TYPE CHARGED PARTICLE ENERGY ANALYZER. Takumi, Kenji; Yamamoto, Hisashi; Ikegani, Hidetsugu (to Kabushiki Kaisha Hitachi Seisakusho). U. S. Patent 3,681,599. 1 Aug 1972. Priority date 16 Apr 1962, Japan.

A sector-type charged particle energy analyzer has a pair of mutually confronting sector-type magnetic poles and an incident opening through which charged particles to be analyzed are projected to the inner part of the analyzer from its outer part formed in the gap between the magnetic poles. The outer energizing coil is wound, within a gap between the pair of magnet poles, flatly expanded in a direction perpendicular to the symmetrical plane of the magnetic poles so as to render uniform the distribution of the magnetic field in the gap between the magnet poles, and, at the same time, this outer energizing coil is divided into upper and lower parts at the position of the incident opening to render it possible to increase as much as feasible the incident angle of the charged particles projected into the inner part of the analyzer thereby increasing the analytical performance of the charged particle analyzer. (auth)

56282 FAST RECOVERY, HIGH INPUT IMPEDANCE TUNNEL DIODE COMPARATOR. Ghelfan, P. (M. G. Electronics Ltd., Rehovot, Israel). Nucl. Instrum. Methods; 103: No. 2, 405-6 (1972).

A tunnel diode comparator is described, which combines a short recovery time with a high input impedance. (1 figure) (auth)

56283 PULSE HEIGHT ANALYZER—CARD PUNCH INTERFACE. Hall, H. E. Jr. (Sam Houston State Univ., Huntsville, Tex.). Nucl. Instrum. Methods; 103: No. 2, 423-4(1972).

A simple, reliable, but relatively slow pulse height analyzer—card key punch interface is described which punches one card, containing channel identification and ten data channels, every eight seconds. The interface operates between a Nuclear Data Model 2200 pulse height analyzer which has a typewriter output and an IBM Model 026 key punch. This system was developed in connection with a project involving nuclear geochemistry. The Nuclear Data typewriter drive was obtained with channel identification and, as received, had nonsignificant zeros suppressed. The IBM 026 key punch was received with no modifications. (1 figure) (auth)

56284 CONVERSION LAYERS WITH GADOLINIUM CONTENT FOR NEUTRON RADIOGRAPHY. Simane, Cestmir (Technical Univ., Prague); Bradna, Frantisek; Simanova, Ruzena. Jad. Energ.; 18: No. 9, 289-96(Sep 1972). (In Czech).

The preparation of neutron conversion layers containing fine grain precipitates of oxalate of gadolinium in gelatin emulsion layered on triacetate foils using aluminum and glass as backing materials is described. The influence of nuclear properties of the backing material on the quality of the neutron radiographs has been estimated theoretically and experimental results concerning the gadolinium content and its homogeneous distribution by neutron transmission measurements in a monoenergetic neutron beam are given as well as the exposure curve and attainable resolution. The conversion layers are suitable for preparation of large size convertors with a well defined gadolinium content up to 5 mg/cm^2 for use in the direct radiography method with a resolution of about 0.1 mm. As compared with metal gadolinium foils, the most distinctive feature of the convertors described is the ease of their preparation, considerably lower price, and minimum gadolinium losses at preparation. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 55815 and 56072.

56285 (CONF-720627--, pp 5.1-19) ENRICHMENT OF URANIUM. Alder, K. F.; Miles, G. L. (Australian Atomic Energy Commission, Sydney).

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

A survey of the state of uranium enrichment technology was made and the gaseous diffusion, centrifuge, and separation nozzle processes are described. Reference is made to Australian requirements for enriched uranium. (Australia)

56286 (FRNC-TH-213) CERTAIN ASPECTS OF MOLECULAR DIFFUSION IN VORTEX FLOW: POSSIBLE APPLICATIONS TO THE ISOTOPIC SEPARATION BY FIXED WALL CENTRIFUGATION. Guilloud, Jean-Claude (Universite Scientifique et Medicale de Grenoble (France)). 1971. 276p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The general equations for the molecular diffusion of a gas are presented. Some aspects of the molecular diffusion-separation in a linear gas mixture are studied. Applications to vortex flow are considered. Certain examples of secondary flow associated with the vortex flow are given which concern fixed wall centrifugation. The flow produced by a vortex filament situated along the axis of a cone and the flow in the vortex plane are studied. The existence of an exact solution for a compressible fluid is demonstrated. The experimental installation is described: vortex tube, test loop, and compressor group. Aerodynamic measurements and concentration measurements are used. The aerodynamic characteristics of the vortex tube are given. (France)

56287 (LIB/Trans-293) ULTRACENTRIFUGATION: A COMMERCIAL BUSINESS AND A POLITICAL OPERATION. Malleroy, Antoine . Translated by H. W. Groenewegen (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from Recherche (Paris); 1: No. 1, 77-80(1970). 7p. Dep. NTIS (U. S. Sales Only).

The structure and organization of the English-FRG-Netherlands agreement relating to ultracentrifugation development is outlined. The proposed program and its financial and quantitative impact are described with respect to the European market and to centrifuge technology developments. (Australia)

56288 (LIB/Trans-428) CALCULATION OF THE STATIONARY OPERATIONAL CHARACTERISTIC OF A TEN STAGE SEPARATION NOZZLE CASCADE. Fritz, Wolfgang (Karlsruhe Univ. (West Germany). Translated by U. Engelbert (Australian Atomic Energy Commission), from a German report. 39p. Dep. NTIS (U S. Sales Only).

Thesis.

A pilot plant is used for the experimental investigation of the controller action of a separation nozzle cascade. Because of the relative low number of stages of this plant, it is only possible to realize a limited number of operating conditions. It is the aim for the present work to develop a method of calculation which makes it possible to determine the operating conditions of arbitrary separation nozzle cascades from the experimentally determined characteristics of their components. The usefulness of this method of calculation is shown by means of a simulation of the tests performed with the pilot plant. Subsequently the predetermination of experimentally as yet unrealized operating conditions of a separation nozzle cascade is given. (Australia)

56289 (MLM-1111) THERMAL DIFFUSION OF XENON ISOTOPES: PRELIMINARY STUDIES. Haubach, W. J.; Eck, C. F.; Grove, G. R. (Mound Lab., Miamisburg, Ohio). 1 Sep 1962. Contract AT-33-1-Gen-53. 29p. Dep. NTIS.

Declassified 28 Oct 1971.

Preliminary data are presented on the optimum pressure and equilibrium time for separation of fission-product xenon isotopes in 0.75-inch diameter hot wire thermal diffusion columns, 24 feet long. The temperatures of the hot wire and cold wall were approximately 900 and 20°C respectively. Preliminary data on the operation of a three column, simple series system for enriching xenon-136 are also included. (auth)

56290 (MLM-1904) STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION: JANUARY-MARCH 1972. (Mound Lab., Miamisburg, Ohio). 10 Jul 1972. Contract AT-33-1-GEN-53. 35p. Dep. NTIS.

Results of research are presented on carbon isotope separation by CO distillation, chemical exchange, thermal diffusion, and carbonate conversion. Work on separation of gaseous isotopes of Ar, He, Kr, Ne, and Xe is described. Thermal diffusion research is reported on molecular beam scattering, molecular beam quadrupole detectors, transport properties, ^{3}He distillation, and vapor pressure ratio in mixed ^{20}Ne and ^{22}Ne. (T.D.)

56291 (NP-tr-1939) URANIUM ISOTOPIC SEPARATION STUDIES IN FRANCE. Lebrun, C.; Mezin, M. Translated by J. P. Ikenberg (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from Energ Nucl. (Paris); 14: No. 1, 5-16(1972). 20p. Dep. NTIS (U. S. Sales Only).

Construction and operating experience at the Pierrelatte enrichment plant are described. The bases for a civil enrichment plant are evaluated particularly from the objective of economic commercial use. (Australia)

56292 (WASH-1221) CONSOLIDATED NOTES OF U. S. VIEWS EXPRESSED AT TWO EXPLORATORY DISCUSSION MEETINGS ON POSSIBLE USE IN A MULTINATIONAL FACILITY OF U. S. GASEOUS DIFFUSION TECHNOLOGY FOR THE ENRICHMENT OF URANIUM, NOVEMBER 1-2; 16-17, 1971, WASHINGTON, D. C. (Atomic Energy Commission, Washington, D. C.). 1971. 57p. Dep. NTIS.

On two different occasions, representatives of the USAEC and Dept. of State met with representatives of a number of countries who had responded favorably to the United States' offer to engage in exploratory discussions concerning possible use of United States gaseous diffusion technology in uranium enrichment facilities undertaken on a multinational basis. Notes of the two discussion meetings are attached. They concern the oral and written presentations made by the U.S. and, at the request of the delegations participating in the meetings, are in the form of questions and responses. They are grouped into four topical areas: aspects of the enriched uranium demand-supply situation; technical and economic aspects of a gaseous diffusion plant; aspects of the major conditions important to the U.S.; and other aspects. A copy of the written presentation handed out by the U.S. at the Nov. 16-17 meeting is appended. (P.C.H.)

56293 METHOD OF COMPENSATING THE VARIATION IN THE LENGTH OF A CENTRIFUGAL BOWL. Bourgain, Louis; Paris, Francois (to Commissariat a l'Energie Atomique). French Patent 2 093,144. 28 Jan 1972. Filed 3 Jun 1970. (In French).

A method of compensating the variation in the length of a centrifugal bowl used for the isotopic enrichment of U is presented. The ends of the bowl are connected to two shafts that ensure the centralizing and the rotation of the bowl along the same axis as the shaft. The ends of the bowl are deformed by the action of couples produced by centrifugal forces acting on these ends such as to increase the distance between the points of fixation of the shaft onto the bowl, this length being equal to the decrease in length due to the Poisson effect. The ends of the bowl are in the form of a deformable cone, the apex of which forms the point of fixation of the driving and centralizing shafts. (France)

56294 CALCULATION OF STEADY STATE SEPARATION PROCESSES OF MULTICOMPONENT ISOTOPE MIXTURES IN PACKED COLUMNS. Vereninov, I. A.; Rakitskii, Yu. V. At. Energ. (USSR); 32: No. 6, 499-501(Jun 1972). (In Russian).

A mathematical model is proposed for a separation cascade for an n-component mixture by a two-phase mode in the absence of isotopic exchange. An equation is developed which is susceptible to solution by digital computer, with an estimated time of solution of 3 min, and an error of not more than 0.2%. (K.S.W.)

56295 DESIGN CONSIDERATIONS FOR THE RPI THREE-STAGE ISOTOPE SEPARATOR. Whitehead, T. Wilson; White, F. A. (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Instrum. Methods; 103: No. 3, 437-45(1972).

The general design criteria for the RPI isotope separator were selected on the basis of planning for medium ion beam currents yielding a system capable of separating microgram to milligram quantities of pure stable nuclides. The determination of design parameters is explained, and the rationale for constructing this instrument is presented. The RPI isotope separator uses a unique ion-optical system of three magnetic lenses to accomplish the goal of maximum isotopic purity. (auth)

56296 DEVICE FOR COMPENSATING THE AXIAL LOAD OF A ROTATING MACHINE. Badie, Michel; Bourgain, Louis;

Samson, Gerard (to Commissariat a l'Energie Atomique). French Patent 2,087,757. 31 Dec 1971. Filed 29 May 1970. (In French).

A device for compensating the axial load encountered in high velocity machines (centrifuges for isotopic separation) is presented. The rotating parts of the machine are supported by a thrust bearing. This rotating part is provided with a rotor driven by a motor situated at the base of the equipment. The device possesses a bushing, which rotates inside a centralizing bearing supported by a fixed mounting. The bushing and the bearing isolate a volume, which contains the rotor from a compartment housing the other of the device; the pressure in this volume is less than that of the external atmosphere. (France)

56297 PRODUCTION OF HEAVY WATER EMPLOYING A GROUP VIII CATALYST. Mikovsky, Richard J. (to Mobil Oil Corp.). U. S. Patent 3,681,021. 1 Aug 1972. Filed 31 Mar 1970.

Heavy water is produced in a liquid-gas-solid reaction system employing a catalyst comprising a Group VIII metal on a resin support. (Official Gazette)

56298 SYSTEM FOR DAMPING THE VIBRATIONS OF A PART ROTATING AT HIGH VELOCITY. Bourgain, Louis (to Commissariat a l'Energie Atomique). French Patent 2,087,756. 31 Dec 1971. Filed 29 May 1970. (In French).

A system for damping the vibrations of a part rotating at high velocity around a vertical axis and supported by an arm (e.g., centrifuge bowl used for the separation of isotopes) is presented. The system is provided with a track, fixed to the rotating part, or the arm, and positioned below the center of gravity of the rotating part. A friction device, which rubs against the track is maintained, radially, by a guide system attached to a fixed mounting and pushed towards the friction surface by elastic devices. (France)

56299 LONG-TERM SUPPLY OF ENRICHED URANIUM TO THE EUROPEAN COMMUNITY. Metall; 26: No. 7, 760(Jul 1972). (In German).

The needs for enriched uranium are projected for the European community. At the present time, three different approaches to enlarge uranium enrichment capabilities are being followed. These efforts should be coordinated especially with respect to gaseous diffusion and the centrifuge method. Although the development of two competitive methods may be useful, it appears necessary that all efforts should be concentrated on only one procedure as soon as it has proved itself to be the most economical one. (H.B.G.)

56300 STEAG'S COOPERATION IN THE SEPARATION NOZZLE DEVELOPMENT. Deut. Forschungsdienst, Sonderber. Kernenerg.; 16: No. 26, 124-5(1971). (In German).

The STEAG (Essen/Germany) has signed an agreement in March 1970 with the Nuclear Research Center Karlsruhe on the further development and the industrialization of the separation nozzle procedure for uranium enrichment. The goal of the cooperation is to establish the preconditions for commercial uranium isotope separation. The short-range goal is planning, design, and operation of a demonstration plant. (INIS)

56301 URANIUM ENRICHMENT: AN IMPORTANT STEP IN THE FUEL CYCLE. Inform. Bild. Wiss.; No. 9, 130; 132-4 (1971). (In German).

The steadily increasing demand for separation work in Western Europe calls for an enlargement on the separation capacities which are available at present, and necessitates the establishment of new isotope separation plants in Europe as well. The different methods of uranium isotope separation are briefly described and the state of international cooperation is outlined. An agreement between Germany, U.K. and the Netherlands has been achieved on a cooperation in the development and utilization of uranium enrichment by gas centrifugation. An international industrial association has been founded which will work for the further development. The construction and the operation of separation plants on the basis of the experience gathered up to now is discussed. (INIS)

Isotopic Power Sources

Refer also to abstracts 55951, 55952, 55973, and 58322.

56302 (LA-5021-PR) QUARTERLY REPORT ON THE SPACE ELECTRIC POWER R AND D PROGRAM FOR THE PERIOD ENDING JULY 31, 1972. (Los Alamos Scientific Lab., N. Mex.). Aug 1972. Contract W-7405-eng-36. 13p. Dep. NTIS.

Five ceramic-metal multilayers have been fabricated for inclusion in the Experimental Breeder Reactor (EBR-II) and are being assembled into Isothermal Irradiator Capsule K-5, together with 11 specimens from Gulf General Atomic Co. (GGA). Difficulties in testing the heat pipe for this capsule have been overcome, and tests of the prototype unit show that, with the pipe operating at 745°C, a threefold increase in power transmitted down the pipe increases the operating temperature by ~30°C. Guard-ring measurements of the specific resistance of yttria that has been incorporated into a Nb$-$1% Zr sheathed trilayer unit by plasma-arc spraying and subsequent autoclaving indicate that at 750°C an electric field of 400 V/cm causes the resistance to decrease with time. After 800 h the specific resistance has dropped to $\sim 4 \times 10^4$ Ω cm; the rate of decrease at this time was much less than the initial rate but was still nonnegligible. Disassembly of EBR-II Irradiation capsules K-3 and K-4 has been completed and posttest diagnostic measurements are in progress. Initial dimensional increase data show that cylindrical shell specimens of Al_2O_3 with an average grain size of 2 μm and of $Al_2O_3$$-$30 vol.% Nb cermet are equivalent in dimensional stability and that both may be slightly more stable than the 5-μm alumina tested earlier. A sapphire specimen irradiated at ~750°C increased dimensionally almost exclusively along the c-axis of the crystal structure. Yttria with an addition of 10% ZrO_2 showed no dimensional increase. Visual examination of trilayer specimens from capsules K-3 and K-4 revealed that ungraded Al_2O_3 over Nb$-$1% Zr bonds separated even at neutron fluences below 2×10^{21} n/cm² ($E_n > 0.1$ MeV). Ungraded Al_2O_3 over niobium bonds was more resistant to neutron damage, but partial debonding occurred for neutron fluences of 2.7×10^{21} n/cm² and greater. No separation was seen for trilayers with graded $Al_2O_3$$-$Nb bonds, but exposures were limited to 2.5×10^{21} n/cm². Trilayers fabricated with Y_2O_3 and either niobium or Nb$-$1% Zr revealed no obvious debonding at neutron fluences up to 4.8×10^{21} n/cm², whether graded or not. A trilayer specimen fabricated with an $Al_2O_3$$-$30 vol.% Nb cermet seemed undamaged after having been exposed to a neutron fluence of 3.7×10^{21} n/cm² at 750°C. Metallic inclusions in UO_2 irradiated in contact with CVD tungsten for 10,178 h at 1600°C have been identified by electron-microprobe examination to be tungsten. Both tungsten and metallic fission-product alloy inclusions have been identified in the UO_2 of a tungsten-clad thermionic emitter that operated at open circuit for 76 h near the end of a 1374-h irradiation test. (auth)

56303 (MLM—1166) CHARACTERISTICS OF ISOTOPIC FUELS. Grove, G. R.; Vallee, R. E.; Lonadier, F. D. (Mound Lab., Miamisburg, Ohio). 8 Jul 1963. Contract AT-33-1-Gen-53. 15p. Dep. NTIS. Declassified 2 Nov 1971.

Plutonium-238 and ^{210}Po metal are presently being used as nuclear fuels, while other forms of these isotopes are being studied in the same application. Alpha particle kinetic energy from encapsulated isotopes is converted to heat energy, which is then converted by thermocouples to electrical energy. Mound Laboratory prepares and encapsulates heat sources to be used in the SNAP program. Plutonium-238 is an alpha emitter with a relatively long half-life (86.4 years), low gamma radiation, and high specific activity. The metal is prepared from material from Savannah River Project. Plutonium metal processed by Mound Laboratory has a nonradioactive impurity content of less than 2.00% and a specific power of 0.442 watt per gram. Plutonium-238 dioxide is being studied as a fuel because of its stability at high temperatures. The oxide, prepared by low or high-temperature sintering, has a specific power of 0.384 watt per gram. This fuel form is easy to handle and encapsulate; however, the metal, with a higher specific power, has been used in all plutonium-238 heat sources assembled to date. Polonium-210, an alpha emitter with a half-life of 138.4 days, is a second possible isotopic fuel. The metal has a specific power of 144 watts per gram. This isotope is applicable to short-term missions. Rare earth polonides, especially gadolinium polonide, offer the possibility of a fuel form which is stable at high temperatures. Mound Laboratory has encapsulated SNAP-3 and SNAP-9 heat sources. These sources consist of ^{238}Pu metal welded inside a tantalum capsule which is then sealed inside a Haynes Alloy-25 outer capsule. (auth)

56304 IMPLANTABLE NUCLEAR POWERED PHRENIC NERVE STIMULATOR (DIAPHRAGM STIMULATOR). Hursen, T. F. (Atlantic Richfield Co., Richland, Wash.); Kolenik, S. A.; Johnson, W.; Furman, S.; Parker, B. pp 272-6 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A nuclear powered phrenic nerve stimulator is described of which a single system has been fabricated as a prototype. The device is fully implantable, has been designed for an operating life of ten years and is about the size of a conventional chemical battery powered heart pacemaker. (auth)

56305 NUCLEAR POWERED VAPOR CYCLE HEART ASSIST SYSTEM. Huffman, F. N. (Thermo Electron Corp., Waltham, Mass.); Coleman, S. J.; Bornhorst, W. J.; Harmison, L. T. pp 277-87 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The function of the implantable ^{238}Pu-fueled heart assist system is to assume a large fraction of the work of the natural heart by removing the entire cardiac output of the left ventricle at low pressure and boosting it in pressure so that it can perfuse the systemic system. The power to drive the blood pump is obtained by converting a fraction of the nuclear heart output into mechanical energy via a miniature vapor cycle engine. Previous studies have utilized rotary and linear steam engines. In these miniature engines, the leakage losses through valves and sliding seals have resulted in unacceptably low efficiency. A new heart assist system driven by an electronically-controlled tidal regenerator engine (TRE) which contains neither valves nor sliding seals is described. In addition to improved efficiency and reliability, the system weight and volume are significantly reduced. The TRE is a vapor cycle analog of the regenerative gas cycle engine which combines the advantages of the Rankine engine with those of the Stirling engine. The TRE has components in common with both the Rankine engine (e.g., boiler, superheater and condenser) and the Stirling engine (e.g., displacer piston, power piston and vapor regenerator) as well as components unique to the TRE (e.g., tidal regenerator and interface piston). For the artificial heart application, it is practical to replace all pistons with bellows. The heat source subsystem consists of the ^{238}Pu capsule, thermal energy storage material and vacuum foil insulation. In the event of engine malfunction, the fuel capsule temperature is limited to within about 100°F of its normal operating temperature of 950°F by a variable conductance heat pipe. If the heat pipe should fail, the system is protected by a thermal fuse which spoils the vacuum of the foil insulation at approximately 1500°F. The TRE pressurization (typically from 5 to 160 psia) is controlled by a displacer piston actuated by a latching binary solenoid. Only about 0.05 ml of water need be displaced to control the TRE pressure. The electrical power for the sensor, electronic logic and solenoid is provided by a thermoelectric module which is interposed between the superheater and the boiler. A dc-dc converter provides voltage levels of 12 and 35 volts. The TRE is directly coupled to an assist blood pump. In addition to its primary function as a pump, the assist device acts as a blood-cooled heat exchanger, pressure-volume transformer and sensor for the electronic logic. The control system automatically counterpulses regardless of the beat rate or stroke volume of the natural heart. (auth)

56306 DEVELOPMENT OF A STIRLING ENGINE POWER SOURCE FOR ARTIFICIAL HEART APPLICATIONS: A PROGRAM REVIEW. Riggle, P. (McDonnell Douglas Astronautics Co., Richland, Wash.); Noble, J. E.; Emigh, S. G.; Martini, W. R.; Harmison, L. T. pp 288-98 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

An efficient radioisotope-powered heat engine with thermal storage offers significant advantages in size, weight, and lifetime over alternate choices for implantable artificial heart power sources. Heat is stored in a molten-salt thermal reservoir. The engine pumps liquid at a pressure difference of approximately 200 psi. Operation as a direct pumping system eliminates large bearing loads and conventional flywheels, thereby reducing system size and weight. The current system delivers 2.72 W (hydraulic) to the aorta with 40 W heat input. Projections for an advanced system indicate the same power can be delivered with 25 W heat input. Results of mechanical and thermodynamic component tests, in-vitro and in-vivo system tests, and important design features and problems are discussed. (auth)

56307 PRELIMINARY DEVELOPMENT OF AN IMPLANTED RANKINE STEAM CONVERSION SYSTEM FOR CIRCULATORY SUPPORT. Purdy, David L.; Blair, McClellan G. (Nuclear Materials and Equipment Corp., Apollo, Pa.). pp 299-309 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The preliminary development effort on a radioisotope-powered circulatory support device for total heart replacement or assist is described. The system is a hybrid or cascaded thermal engine—the first stage being a thermoelectric conversion cycle; the second, a Rankine steam cycle. The hybrid concept provides a higher cycle efficiency than a single Rankine cycle. The electrical energy from the thermoelectric cycle is used to operate both the Rankine cycle feedwater pump and valves and to provide power for electronic control. The system control function can sense a variety of physiological functions with the design described controlling output according to right atrial pressure. Heat from the system is rejected to the blood in a heat exchanger which is insensitive to attitude, and helium from the radioisotope decay is vented to body tissue. The system is small in size, being 380 cc in volume, weighs less than 1.82 pounds, and is designed to be easily integrated with artificial ventricle blood pumping chambers. (auth)

56308 BYPASS GAS ACTUATED THERMOCOMPRESSOR AS AN IMPLANTABLE ARTIFICIAL HEART POWER SOURCE. Gibson, B. M. (Air Products and Chemicals, Inc., Allentown, Pa.); Hornbeck, C. J.; Longworth, R. C.; Harmison, L. T. pp 310-16 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A thermocompressor in which the displacer is actuated by a fraction of the compressed gas is being developed as a power source for an implantable artificial heart. This type of compressor was first described in U.S. Patent 2,157,229 and is sometimes referred to as a Bush compressor after the original inventor. Principal feature of this unit is that some of the compressed gas is diverted through a small double acting piston on the displacer drive stem to cause it to reciprocate. Displacer speed is approximately proportional to the pressure difference across the drive piston, which in turn is set by a controller that acts to maintain a constant pressure difference between the high and low pressure reservoirs. The drive piston ball valves are set in their alternate positions by a snap spring, which stores the energy required to change positions during a stroke. Inertia is thus not required to carry the displacer through a cycle, so the unit cannot stall as long as there is a nominal pressure difference between the gas reservoirs. Weight of the reciprocating mass is also very small. The engine has run self-sustaining at speeds from 1 to 35 Hz, with reservoir pressures of 1200/1000 psig. Maximum measured power output to data has been 10 W, assuming isothermal expansion, at a speed of 17 Hz. Overall thermal efficiency data are also presented. (auth)

56309 DESIGN AND PRELIMINARY TESTING OF A BRAYTON SPACE RADIATOR CONCEPT. Miller, T. J.; Couch, J. P.; Prok, G. M. (Lewis Research Center, Cleveland). pp 403-8 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A low temperature radiator has been designed to reject 17.62 kW of thermal power from an isotope Brayton power system. This power system has an electrical output of 7.1 kW. The total radiator consists of two radiators connected in series. Both radiators have a redundant coolant loop, shared fins, and are close to flight configuration. A silicone oil (2 cs viscosity at 537°R) is used as the working fluid. Low flow rates and moderate pressure drop in the radiator required a small hydraulic diameter with large heat transfer area and large flow area. To obtain these characteristics and meet schedule limitations, an expanded tube configuration (with an approximate trapezoidal cross section) was selected. Because of the low flow rates and unconventional tube shape, small-scale tests were performed to evaluate the validity of existing heat transfer and pressure drop correlations to this case. The results of these tests were in good agreement with predictions. The radiators are designed for a 0.99 probability of no punctures during a 5 year space mission and are radiating to a 450°R effective sink temperature. The high temperature radiator has an inlet temperature of 746°R, an outlet temperature of 565°R, an effective Reynolds number of 648, a weight of 344 pounds, and an area of 281 ft^2 to reject 12.07 kW of thermal power. The low-temperature radiator has an inlet temperature of 565°R, an outlet temperature of 531°R, an effective Reynolds number of 469, a weight of 511 pounds, and an area of 292 ft^2 to reject 5.55 kW of thermal power. (auth)

56310 ISOTOPE–BRAYTON MODULAR POWER SYSTEM FOR THE SPACE STATION. McCarty, L. H. (General Electric Co., Philadelphia). pp 452-63 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The 25 kWe Isotope-Brayton Modular Power System is an exceptionally flexible and compact space power system that fulfills all of the Space Station power requirements and is compatible with projected Space Station operations and experiments. The system discussed here uses plutonium-238 as fuel, is 20 feet in diameter, 42 feet long, and weighs approximately 20,500 pounds, including two inches of lithium hydride shielding for neutron attenuation.

Although this particular system consists of four modules, any number of modules from four to perhaps six or seven may be employed, thereby providing the power system engineer with a useful design tool that permits emphasis of selected performance characteristics such as high reliability or low system weight. The in-orbit operations involved to install or replace power system components with the Space Shuttle (ALS) have been developed in some detail and are presented here. (auth)

56311 STUDY OF THE MULTIPLE SKIP REENTRY CONDITION AND ITS EFFECT ON THE MHW RTG HEAT SOURCE DESIGN. Quinn, James E. pp 635-48 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

One of the design conditions associated with a Radioisotope Thermoelectric Generator (RTG) heat source is to survive a multiple-skip reentry occurring as a result of a mission abort. The multiple-skip reentry condition occurs if the heat source velocity and path angle when it intercepts the earth's atmosphere following the mission abort do not result in an immediate reentry to earth impact, or "capture," but rather the heat source leaves the earth's atmosphere and enters an elliptical earth orbit. Subsequently, the heat source continues to reenter the earth's atmosphere, or skips, losing velocity during each skip, until finally "capture" and earth impact occurs. This condition is potentially severe because the heat source aeroshell can undergo significant ablation during these skips, and the cumulative effect could substantially increase the required thickness of aeroshell ablative material. The general problem of multiple-skip reentries, with emphasis on earth escape initial velocity, is discussed. The Multi-Hundred Watt (MHW) RTG Heat Source Design, due to its potential mission applications must reflect consideration of the multiple-skip reentry condition. Therefore, the study examined the specific behavior of the MHW Heat Source with respect to aerodynamics, trajectories, heating profiles, thermal response and aeroshell ablation. The study also considers the potential of utilizing a heat source outer metallic clad for aerodynamic heating protection, thereby decreasing the required aeroshell ablative material thickness. The analytical methods and assumptions employed in the study are presented as well as the study results and the conclusions reached. The numerical results, although specific to the MHW, can be applied to other radioisotope fueled heat sources after appropriate modifications are made or additional analyses performed. It is demonstrated that the MHW Heat Source Design will survive all multiple skip reentries at earth escape initial velocities, and will do so with very "conservative" assumptions applied. (auth)

56312 LARGE ^{60}Co HEAT SOURCE PROGRAM. Sadler, J. W.; Parker, G. H. (Westinghouse Electric Corp., Large, Pa.). pp 741-50 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The design features are described for a nominal 30 kW(t) ^{60}Co heat source. Detailed design of the heat source was completed in 1970, fabrication and assembly will be completed during 1971 and demonstration testing is scheduled for 1972. The heat source is gas-cooled with outlet temperature capability up to 1350°F. The source features a passive emergency cooling system consisting of 36 sodium heat pipes. Component tests to qualify the heat pipes are being performed during 1971. Plans for demonstration testing of the heat source are presented along with a description of the test loop and its operational, control, and safety provisions. Plans for follow-on testing of the heat source mated with Brayton and Rankine power conversion equipment are also discussed. (auth)

56313 PRODUCTION AND PROPERTIES OF REFRACTORY FORMS OF ^{60}Co FOR ISOTOPIC POWER APPLICATIONS. Rankin, D. T.; Smith, P. K.; McBeath, P. E.; (and others) (E. I. du Pont de Nemours and Co., Aiken, S. C.). pp 751-60 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The β,γ-emitter ^{60}Co is a low cost ($10 to 20/W(t)) and readily available isotope for heat sources in isotopic power applications. Materials systems have already been developed for the potential application of ^{60}Co metal in devices operating up to 1000°C. At lower power densities the oxides CoO, $Co_{0.5}Mg_{0.5}$, and $CoAl_2O_4$ are now identified as refractory forms of ^{60}Co suitable for applications at higher temperatures required for thermodynamic engines and thermionic devices or for applications at lower temperatures when fully oxidized forms are desired for special safety requirements. Fabrication processes, irradiation demonstrations, compatibility exposures, and properties are described. Conventional powder ceramic processes have been developed to fabricate each oxide into 90% dense wafers (0.70 inch diameter by 0.15 inch thick) suitable for irradiation to convert natural ^{59}Co to ^{60}Co. Hydroxides of these isotopes are coprecipitated from nitrate solutions, calcined to oxide under inert gas, pressed, and sintered. Techniques have been developed to preclude formation of Co_3O_4 and preferential vaporization of cobalt oxide during sintering. Wafers of all three oxides were successfully irradiated in control rods of a Savannah River Plant reactor to produce a total of 7.5 kW(t) at activities up to 700 Ci/g of cobalt. Maximum power densities at discharge were 50, 25, and 15 W(t)/cc for CoO, $Co_{0.5}Mg_{0.5}O$, and $CoAl_2O_4$, respectively. Wafers were discharged from the reactor intact and can be directly encapsulated without reprocessing. Preliminary data show that rhenium and iridium are compatible with all three oxides. TIG welding encapsulating techniques have been developed for powder metallurgy and arc cast rhenium capsules. No solid state reaction occurred between rhenium and any of the oxides at 1500, 1700, and 1850°C for times up to 1000 h. However, vapor transport of the rhenium capsule, possibly as $ReO_3(g)$, in a temperature gradient, restricts the use of rhenium capsules for 5 y to below 1300°C. Preliminary experiments at 1500°C for 1000 h show iridium should be a suitable capsule material at higher temperatures. Thermal conductivities, melting points, phase behavior, thermal expansions, strengths, thermal shock resistances, particle sizes on fracture, water corrosion, and oxidation behavior were measured. (auth)

56314 SCALING LAWS FOR FUEL CAPSULES SUBJECTED TO BLAST, IMPACT, AND THERMAL LOADING. Duffey, Thomas A. (Sandia Labs., Albuquerque, N. Mex.). pp 775-86 of 1971 Intersociety Energy Confersion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Scaling laws are presented for fuel capsules subjected to blast, fragment, and earth impact, as well as thermal loading. It is generally shown that fuel capsules can be simulated during testing by small-scale capsule models of identical materials as the prototypes, and in certain instances by models constructed of dissimilar materials. Problem areas for both testing techniques are isolated. The scaling laws for fuel capsule impact are validated over a limited range in impact velocity by an experimental program in which models and prototypes are constructed of similar materials. (auth)

56315 RADIOISOTOPES: FAMINE OR FEAST: A REVIEW OF AVAILABILITY. Graf, James C.; Brown, Paul E. (General Electric Co., Philadelphia). pp 918-32 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

To be of use as an energy source in power conversion systems, a radioisotope must be available in the quantity and form required for the application. Although the AEC currently remains the major source of radioisotopes for conversion systems, the proliferation of commercial nuclear power reactors in the next ten years will generate large quantities of fission products and transuranium elements as by-products of operation which can potentially be recovered and used. The nuclear and radiation properties of these nuclides and the thermal characteristics of the most probable chemical form of each are summarized. The limitations on usefulness imposed by specific power, half-life, and other factors are presented. The projected availability of a number of these isotopes and their possible costs are assessed. (auth)

Radiation Sources

Refer also to abstracts 56036, 56759, 56764, 56769, and 56790.

56316 (AAEC/LIB/Bib-353) TRITIUM LIGHT SOURCES. A Bibliography. Newland, E. A. (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1972. 20p. Dep. NTIS (U. S. Sales Only).

Sixty-four references are listed alphabetically within each year for the period 1953 to 1971 under the headings tritium lights, selected general references on tritium, and select references dealing with safety aspects of tritium. (Australia)

56317 (KFK-1567) MEASUREMENT OF THE WEAR AND KINEMATIC BEHAVIOR OF FAST RUNNING BALL BEARINGS WITH THE HELP OF RADIOACTIVE ISOTOPES. Herkert, Bernhard (Kernforschungszentrum, Karlsruhe (West Germany). Laboratorium fuer Isotopentechnik). Feb 1972. 86p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Karlsruhe Univ. (West Germany).

Measurements on high-speed and lightly loaded ball and roller bearings were made to investigate the kinematic and wear behavior. Shaft displacements (by capacitance means), cage speeds (with optic pickup), and the speed of rollers in a roller bearing (by point marking one roller with radioisotopes) were also measured. Continuous wear measurements were made on all parts of the bearings, that had been suitably activated with neutrons or deuterons. The results show the running-in behavior and indicate that operation of ball bearings at light load and high cage creep does not affect the wear of a bearing that is run-in. (auth)

56318 DEVICE UTILIZING A RADIOACTIVE TRACER TO MEASURE THE FLUID-TIGHTNESS OF A JOINT. Mayet, R. (Direction des Constructions et Armes Navales, Toulon, France); Margrita, R.; Mornas, A. Rev. Gen. Caout. Plast.; 49: No. 6, 511-13(Jun 1972).

The principle of the device consists of subjecting the outside of the joint under investigation to pressurized tritium-labeled water and then determining the radioactivity of the water having penetrated into the cavity defined by the joint. The leak rate can be measured absolutely, the detection efficiency being very high, e.g., 10^{-7} grams of water. The apparatus developed avoids any radioactive emanations and reduces to the maximum the contamination of the samples. The infrastructure developed may serve as a base for investigations of the permeability of membranes or joints to hydrocarbon fluids. (France)

56319 SURVEY OF MEDICAL RADIATION SOURCES IN TAIWAN. Weng, P. S. (National Tsing Hua Univ., Hsinchu, Taiwan); Cheng, C. H.; Wei, V. H.; Liu, K. Y. Health Phys.; 23: No. 4, 549-53(Oct 1972).

A general survey for radiological health in Taiwan's hospitals and clinics revealed that there are about 63 medical x-ray units/million population and one hospital bed/10^4 population. The number of medical x-ray units/million population in each county or city varied from 31 to 131. About 40% of x-ray units in operation had tube leakage exceeding 100 mR/hr at a distance 1 m from the target. A few hospitals provide therapy with teletherapeutic units, ^{90}Sr applicators, ^{226}Ra needles, and radioisotopes. In contrast to other countries' experience, there was a high proportion of male to female professionals among the x-ray operators in Taiwan. (auth)

56320 PROGRESS IN THE APPLICATION OF RADIOISOTOPES TO THE STUDY OF PRODUCTION TECHNOLOGY IMPROVEMENT IN THE POLISH INDUSTRY. Radwan, Maciej (Inst. of Nuclear Research Swierk, Poland). Nukleonika; 16: No. 9-10, 411-27(1971).

Some recent advances in research in the field of the radioisotopes application in Polish industry are described. The research was concerned mainly with β scattering measurements, x-ray fluorescence techniques, and some new applications of neutron sources. Equipment for thickness measurements and for determination of chemical content of hydrocarbons was fabricated. Studies of metallurgical processes in both steel and nonferrous metallurgy have progressed. Numerous studies concerned with the homogeneity of both the alloys, in the structure of which elements are distributed in a different way, and of the charge materials used in the blast furnace process have been made. Measurements of quantities and degree of purification of industrial wastes and also their distribution in rivers and water reservoirs were studied. Methods to investigate the wear of materials are of special importance in the motor car industry. The more important results obtained in the Polish program of utilization of large radiation sources in medicine and industry are presented. (auth)

56321 STATE PRIMARY STANDARD FOR THE UNIT OF EXPOSED DOSE OF X-RAY AND GAMMA RADIATION. Yudin, M. F.; Ostromukhova, G. P.; Kononova, R. F.; Kochina, M. P. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 2, 185-90(Feb 1972). Translated from Izmer. Tekh.; 15: No. 2, 4-7(Feb 1972).

Comparisons were made of measurements of the unit of exposed dose of x and γ radiation for member countries of the Council for Mutual Economic Aid. Results showed that the deviation of the measurements did not exceed 1.5 to 2%. Information is included on composition of the standard and procedure for reproduction of the unit of exposed dose. (J.R.D.)

Design and Fabrication

Refer also to abstract 57897.

56322 (ORNL-IIC-34(Pt.2)) PATENT LITERATURE ON PROCESS RADIATION AND IRRADIATOR DESIGN. PART 2. BRITISH AND CANADIAN PATENTS 1950 THROUGH 1970. Greene, R. E.; Warren, H. S.; Baker, P. S. (Oak Ridge National Lab., Tenn.). Oct 1972. Contract W-7405-eng-26. 257p. Dep. NTIS.

A compilation of the British and Canadian patent literature from 1950 through 1970 on process radiation and irradiator design is presented. The search program for the identification of relevant patents is described and information on more than 700 patents is included. For each British patent in this period, the number, title, date of issue, date of filing, assignee, patentee (when given), and either an abstract or the most descriptive claim are given; subject and assignee indexes are also given. Lists are appended giving the patent number, title, and assignee of 1971 British patents and 1950 to 1970 Canadian patents which have been acquired. (auth)

56323 IMMOBILIZATION, COMPENSATION, AND FIELD SHAPING IN MEGAVOLT THERAPY. Soerensen, N. E.; Sell, A. (Radium Centre for Jutland, Aarhus, Denmark). Acta Radiol., Ther., Phys., Biol.; 11: No. 2, 129-34(Apr 1972).

A method of producing fully individual treatment shells is described. A system is also presented for controlling the dose distribution of ^{60}Co γ rays and 6 and 32 MeV roentgen rays by individually designed compensating filters with which field shaping by means of lead columns is possible. (auth) (Sweden)

56324 IRRADIATION APPARATUS FOR THERAPY. Barataud, C. (to Barapio SA). Canadian Patent 901,693. 30 May 1972. Priority date 18 Oct 1967, Switzerland.

A therapeutic irradiation apparatus is described, consisting of a protective casing enclosing a support for a gamma source, a solid first filter, a second filter, and adjacent to the part of the casing from which the radiation emanates, and in its path, a neutron source. A high degree of user safety, and prevention of damage to surrounding tissues, is claimed for the device. (Canada)

Industrial Uses

Refer also to abstract 56346.

56325 (TID-25557) COST BENEFIT ANALYSIS OF SELECTED RADIATION PASTEURIZED FOODS. (Economic Research Service, Washington, D. C. Bureau of Commercial Fisheries, Washington, D. C. Dunlap Associates, Manhattan, Kans. (USA). AGRI Div.). Sep 1972. Contract AT(49-11)-3001. 274p. Dep. NTIS.

Potential cost benefits of using radiopasteurization to reduce spoilage losses and extend the shelf-life of certain foods are reported. Sixty-one foods were initially selected for the analysis. Commodity-potential determinations were made in several further selectivity stages. At the end of all selection actions, the six foods that ranked highest in merit for irradiation pasteurization consideration were: strawberries, mushrooms, papayas and mangoes, shrimp, blue crab, and east coast finfish. Based on the results of the study, the future of irradiation-pasteurization in food processing still is uncertain. Commodity summaries, grouped according to selection action results, are given. (P.C.H.)

56326 STERILIZATION OF PACKAGED GOODS. AS 1079 1971. North Sydney, Australia; Standards Association of Australia (1971). 9p. (NP-19409).

Parameters are given for the sterilization of packaged goods using dry heat, moist heat, ethylene oxide, or ionizing radiation. Data on the radiation stability of rubbers, thermoplastics, thermosets, textiles, adhesives, oils, and greases as published by the UKAEA are included. (Australia)

56327 HARDENING OF GELATIN-CONTAINING PHARMACEUTICALS, ESPECIALLY CAPSULES, BY HIGH-ENERGY RADIATION. Huettenrauch, R. (Wissenschaftliche Laboratorien des VEB Jenapharm, Jena, Ger.). Pharmazie; 26: No. 8, 506-7(Aug 1971). (In German).

Hard and soft gelatin capsules were irradiated with radiation doses of 2.5, 5.0, and 10.0 mrad (–5%, +25%, gamma radiation). Disintegration time after irradiation was determined, relative to water, in an Erweka VZ4 instrument. The slip-fit capsules were not affected by the irradiation in terms of disintegration time; however, the seamless capsules hardened. Irradiation reduced the solubility of the gelatin in all instances. The pharmaceutical significance of these phenomena was discussed. Fourteen references are included. (JPRS)

56328 PREPARATION OF WOOD-PLASTIC COMPOSITES BY IMPREGNATION WITH VINYL ESTER MONOMER COMBINATIONS AND POLYMERIZATION WITH GAMMA RADIATION. Garratt, P. G. (Aktiegesellschaft fuer Industrielle Forschung und Strahlennutzung, Schwerzenbach, Switzerland); Hoigne, J.; Heetman, J. G.; Hess; W. Holzforschung; 26: No. 3, 96-102 (1972).

The results of a study aimed at obtaining wood-plastic composites with acceptable physical and mechanical properties by utilizing a comonomer mixture of vinyl acetate and vinyl esters of synthetic monocarboxylic acids of highly branched structures are described. These monomer combinations have in particular the major advantage of being cheap and requiring low radiation doses for complete polymerization in wood. A short technical evaluation of the wood-plastic composites obtained for use in the flooring industry is also described. (auth)

56329 TREATMENT OF FEEDS BY IRRADIATION. Renner, H.; Reichelt, D. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Kraftfutter; 53: No. 4, 152-60(1970). (In German).

The possibility to disinfest or to sterilize feeds by irradiation is discussed from the present technological and microbiological point of view. Probable costs and possible changes in the chemical constituents of the feeds are discussed. Advantages and disadvantages of irradiation are compared with other methods of treatment. The results of numerous animal feeding experiments indicate the wholesomeness of irradiated feeds. In view of the existing law against food irradiation, the use of irradiated feeds might be the beginning of an industrial development of food irradiation in the Federal Republic of Germany. Successful use of irradiated feeds over an extended period of time would increase the safety factor by which radiation treated foods could be recommended for human consumption. (INIS)

56330 IRRADIATION OF FOODSTUFF. Wolf, A. (Inst. of Hygiene and Epidemiology, Prague). Cesk. Hyg.; 16: No. 9-10, 342-7(Dec 1971). (In Czech).

A review is presented of experiments with the irradiation of foodstuff and packaging materials aimed at extending their storage time while preserving their biological values. Sensitivity to radiation of different kinds of foodstuffs and of their components is listed. The radiation effects on certain types of foodstuff, the change in the biological value of protein foodstuffs with irradiation, and the microbicidal effect of irradiation are discussed. (NSA of Czech.)

56331 PRESERVATION OF FRESH FRUIT AND VEGETABLES BY IONIZING RADIATION. Vas, K. Confructa; 16: No. 2, 68-78(1971). (In German).

A survey of the applicability of ionizing radiation in the preservation of fresh fruits and vegetables is presented. The following subjects are discussed, along with reference to technical problems: the process of fruit ripening which can be delayed by ionizing radiation, thus extending the shelf-life and period of conservation; dose-dependent delay of cap formation in mushrooms; extension of shelf-life of potatoes and onions by radioinduced sprout inhibition; irradiation of sugar beets, carrots, and red beets; irradiation for the inactivation of insects on fresh fruit and vegetables; prolongation of microbiological conservation by low levels of radiation (0.1 to 0.6 mrad). This kind of irradiation still offers quite a number of technical problems, as there are some undesired side effects such as a loss of natural phytoimmunity of the plants, due to the effect of ionizing radiation on the plant-inherent antitoxins, the phytoalexines. Minor doses will not affect in situ the enzymes of the plants. Also discussed are the economic aspects of irradiated foods, their wholesomeness, and differences in legislation in various countries. (GF)

56332 IRRADIATION OF LARGE-SCALE MANUFACTURED GOODS IN THE FOOD AND FEEDS INDUSTRY. Tauber, M. (Allgemeine Elektricitaets-Gesellschaft, Hamburg). Ind. Obst-Gemueseverwert.; 57: No. 11, 295-300(1972). (In German).

After a survey on the purpose and possibilities of irradiation and approval of irradiated food (status as of May 1971), arranged according to food, irradiation purpose, radiation doses, countries, and year of approval, suitable irradiation facilities such as ^{60}Co and ^{137}Cs plants, x-ray devices, and electron accelerators are described. (GF)

56333 DESIGN AND CALIBRATION OF A BROAD-BEAM ^{238}Pu, Be NEUTRON SOURCE FOR TOTAL-BODY NEUTRON ACTIVATION ANALYSIS. Cohn, S. H.; Shukla, K. K.; Dombrowski, C. S.; Fairchild, R. G. (Brookhaven National Lab., Upton, N. Y.). J. Nucl. Med.; 13: No. 7, 487-92(Jul 1972).

A neutron irradiation facility designed for performing total-body neutron activation analysis (TBNAA) for clinical research is described. Fourteen 50-Ci encapsulated sources of ^{238}Pu, Be that may be positioned above and below the midline of the subject provide a fairly uniform broad-beam source of neutrons. Absolute levels of total-body Ca, Na, and Cl, and relative levels of P are determined in subjects exposed bilaterally to the neutron flux (average energy, about 5 MeV), for 5 min. The induced ^{49}Ca, ^{24}Na, ^{38}Cl, and ^{28}Al (from P) are measured with a whole-body counter designed with a response invariant with respect to counting geometry and attenuation. This in vivo activation technique provides an accuracy and precision of ±1%, as determined by studies with a phantom. The ^{238}Pu, Be neutron source offers a number of advantages in TBNAA over the previously used 14-MeV neutrons obtained from a neutron generator. The maximum total dose received by a patient is 277 mrem, or 45% of the minimum dose previously required for activation. The reduction in absorbed dose results primarily from reduced tissue dose per incident neutron and increased efficiency for generating thermal neutrons. The reduced dose together with an inherent simplicity in obtaining a uniform neutron flux from the Pu, Be sources, makes the new technique very desirable for TBNAA analysis in medical diagnosis and research. (auth)

56334 PRINCIPLE OF SORTING IN THE TREATMENT OF RAW FOODSTUFFS CONTAMINATED WITH RADIOACTIVE SUBSTANCES. Prokof'ev, O. N.; Pokhvalinskaya, G. V. (Scientific-Research Inst. of Radiation Hygiene, Leningrad). Gig. Sanit.; No. 5, 113-115(May 1972). (In Russian).

The conditions of radioactive contamination of foodstuffs were studied for the purpose of decreasing losses in the food reserves. By reprocessing many products, retaining them for a time with preservation techniques, it is possible essentially to expand the volume of raw foodstuffs remaining within the sphere of food consumption by a population. The decision of the problem of optimizing the assignments can enable one to utilize in the best manner the available productive power with the goal of minimizing the radioactive contamination of the reprocessed products. (K.S.W.)

LIFE SCIENCES

Refer also to abstract 57888.

56335 GENERAL PROBLEMS OF COMPILING DESCRIPTIONS (ALGORHYTHMS) OF RADIATION PECULIARITIES IN RADIOBIOLOGICAL EXPERIMENTS AND OBSERVATIONS. Verkhovskaya, I. N.; Nikiforov, V. S. pp 227-30 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Recommendations were developed concerning the general rules of designing radiation experiments and observations, taking into account the specific conditions of any conceivable radiobiological experiment or observation. (auth)

Radiation Effects on Biochemicals (External Source)

Refer also to abstracts 55837, 56356, 56446, 56449, 56767, and 57887.

56336 DAMAGE AND REPAIR OF DNA IN 5-BROMODEOXYURIDINE-LABELED CHINESE HAMSTER CELLS EXPOSED TO FLUORESCENT LIGHT. Ben-Hur, E.; Elkind, M. M. (Brookhaven National Lab., Upton, N. Y.). Biophys. J.; 12: No. 6, 636-47(Jun 1972).

Illumination of Chinese hamster cells with fluorescent light after 5-bromodeoxyuridine incorporation leads to extensive single-strand breakage in the DNA of the exposed cells. The rate of production of single-strand breaks is dependent on the extent to which thymine is replaced by 5-bromouracil. At least some of the breaks observed with alkaline gradients are probably produced in vivo and are probably not contingent upon alkaline hydrolysis since breakage can be demonstrated with neutral gradients also. Cells are able to rejoin most of the single-strand breaks within 60 min; however, damage to the DNA-containing material (the "complex") initially released from cells is repaired more slowly. Cysteamine protects against single-strand breakage with a dose-modifying factor of 2.8. A comparison is made between the production of single-strand breaks by fluorescent light and x rays, and the significance of such breaks relative to cell survival is discussed. (auth)

56337 ELECTRON SPIN RESONANCE INVESTIGATIONS ON POTATO PEELS IRRADIATED BY HIGH ENERGY AND UNIRRADIATED. Mehringer, W. Z. Lebensm.-Untersuch. Forsch.; 147: No. 5, 278-81(1971). (In German).

Potatoes were stored for 2 months at 4°C and subsequently irradiated with 0 to 30 Mrads of pulsed electrons of about 10 MeV at a mean dose rate of 1.5 Mrads/min. The radicals induced by irradiation were measured in the potato peels by means of ESR-spectrometry. As for small doses, the curve of the dose-dependent number of radicals asymptotically approaches a definite value. Thus difficulties arise in proving the existence of radiation-induced compounds at extremely small doses of about 20 krads. The time-dependent decrease of the number of radicals may possibly be avoided, at least partially, by fast drying of peels. The lifetime of radicals of 3 hrs lies between the half-lives in irradiated aqueous and dry organic systems. Further investigations are needed for elucidating the role of bound water and oxygen in the decay of radicals. (INIS)

56338 CHANGES IN FUNDAMENTAL COMPONENTS OF FOODSTUFFS DUE TO IONIZING RADIATION. Salkova, Z. Bull. Slov. Polnobospod. Akad., Vysk. Ustavu Potravin.; 9: No. 2, 12-19(1970). (In Slovak).

The effect was studied of ionizing radiation on the fundamental components of foodstuffs—water and fat. An experiment was carried out on lard irradiated with gamma-radiation from a ^{60}Co source at a dose rate of 0.5 Mrad/hr with a total dose of 1000 krad. The samples were stored at room temperature. Three stages of oxidation were found. In the first, the induction period, the studied variables did not significantly increase. In the second stage, rapid oxidation was observed resulting in an increased content of peroxides and carbonyls and extinction at 224 and 232 nm. In the third stage, the rate of carbonyl and peroxide formation decreased and the rate of extinction increase was lower. The effect of radiation was found to result in a shortening of the induction period and an earlier formation of carbonyls and peroxides. Radiation also brought about an increase in all initial values of the examined variables. It was also found to speed up the oxidation process without affecting the characteristics of the oxidation changes. (NSA of Czech)

56339 COMBINED EFFECT OF IONIZING RADIATION AND COLD ON STORAGE OF MEAT. Salkova, Z. Bull. Slov. Polnobospod. Akad., Vysk. Ustavu Potravin.; 8: No. 4, 24-8(1969). (In Slovak).

The effect was studied of ionizing radiation on the storage property of pork irradiated with doses of 400 and 600 krad. Chemical and microbiological changes in the meat after irradiation and during storage at temperatures of 0°C, –5°C, and –12°C were examined. Indicators for the evaluation of quality showed that irradiation of meat improved its storage properties, e.g., at a temperature of 0°C from 10 days to 35 to 40 days. (NSA of Czech)

56340 EFFECT OF PARAMAGNETIC IONS UPON FORMATION OF SPORE PHOTOPRODUCT IN DNA IRRADIATED WITH UV AT -196^{0}C. Jido, Y. (Kyoto Univ.); Ikenaga, M.; Sidei, T. J. Radiat. Res.; 13: No. 3, 177-81(Sep 1972).

Amount of spore photoproduct (SP) was estimated by chromatography from ^{3}H-labeled Escherichia coli DNA irradiated with 254 nm uv at –196°C. The amount of SP was greatly reduced by the presence of triplet state quencher manganese during irradiation. Magnesium, which does not quench the triplet, had no effect on SP formation. These results support the view that the excited triplet state of thymine, but not singlet state, is the precursor of SP. (auth)

56341 SULFHYDRYL LEVELS IN X-IRRADIATED THYOCYTES. Myers, D. K. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Int. J. Radiat. Biol.; 22: No. 2, 203-4 (Aug 1972).

Measurements were made of sulfhydryls in total protein and the acid-soluble portion of rat thymocytes after x-irradiation at 0°C, using dose rates of up to 20 Krads/min over a dose range of 0 to 400 Krads. Observations were made immediately following irradiation, or after incubation for 5 hr at 4°C or 37°C. Sulfhydryl levels were not appreciably affected immediately after exposure to doses of 1 Krad. Non-protein sulfhydryls in the acid-soluble fraction were reduced 50% by 100 to 200 Krads. Protein sulfhydryl was decreased by a similar molar amount as the non-protein sulfhydryl, but the percentage decrease was only 16% at 400 Krads. The sulfhydryl levels were compared with previously published data for doses producing cell death in irradiated thymocytes, reflected by loss of cellular potassium, and it is suggested that there was no evidence of a relation between radiation induced cell death and loss of protein and non-protein sulfhydryls. (UK)

56342 AMINO ACID ANALYSIS OF UV-IRRADIATED RIBONUCLEASE A. Mueller, H.-G.; Dettmer, R. (Institut fuer Biophysik, Berlin). Acta Biol. Med. Ger.; 27: 77-83(1971). (In German).

During the ultraviolet inactivation of ribonuclease A, it is initially the half-cystine residues which are photochemically transformed. In addition, there is some destruction of tyrosine, phenylalanine, methionine, and arginine. The destruction of these amino acid residues is accompanied by an increase in the glycine content of the protein; and a probable mechanism for this process is proposed. The significance of the appreciable destruction of cystine in ultraviolet damaged RNase A is discussed; and it is concluded that the inactivation of the enzyme is not due to this source alone. (auth)

56343 INACTIVATION OF DNA-DEPENDENT RNA POLYMERASE FROM ESCHERICHIA COLI BY X RAYS IN SOLUTION. Sumegi, J.; Sanner, T.; Pihl, A. (Norwegian Radium Hospital, Oslo). Biochim. Biophys. Acta; 262: 145-53(14 Mar 1972).

DNA-dependent RNA polymerase from Escherichia coli (holoenzyme) was irradiated in dilute aqueous solution in the presence of air. The enzyme was inactivated as an exponential function of the dose, when the activity was assayed with calf thymus DNA as template, while with T_4 DNA as template a biphasic dose-response curve was obtained. In the initial rapid phase of inactivation 30–40% of the activity was lost at a yield corresponding to G = 0.2. When the initiation factor σ and the core enzyme were irradiated separately, the σ factor was approximately 40 times more radiosensitive than the core enzyme. Blocking of the SH groups of the holoenzyme with cysteamine residues during irradiation gave a strong protection against the rapid initial inactivation observed with T_4 DNA as template. Cystamine incubation of the unirradiated holoenzyme gave a singular biphasic inactivation curve as irradiation. The results indicate that the rapid initial inactivation of the holoenzyme is due to preferential inactivation of the σ factor which is highly radiosensitive due to very reactive, essential sulfhydryl groups. (auth)

56344 NATURE OF THE RADIATION DAMAGE IN THE THYMINE CONTAINING STRAND OF HYBRID BU–DNA AFTER

LONG WAVE-LENGTH U.V. Koehnlein, W.; Moenkehaus, F. (Univ., Muenster, Ger.). Int. J. Radiat. Biol.; 22: No. 3, 293-6(Sep 1972).

The transformation rates of the different DNA fractions extracted from Bacillus subtilis and the defective bacteriophage PBSH are plotted versus uv irradiation dose over a range of 0 to 7×10^{-4} erg/mm^2. It was found that up to 5% in the case of the bacternal DNA, and as much as 12% for PBSH DNA, of the energy absorbed in the B-strand of hybrid DNA could be transferred to the T-strand by means of intramolecular energy transfer. It is suggested that the entire intramolecular energy transfer in hybrid DNA, which causes the additional decrease of the transforming activity, could be attributed to the appearance of single-strand breaks in the thymine containing strand of TB-DNA. (UK)

56345 REPAIR OF STRAND BREAKS IN GAMMA-IRRADIATED MICROCOCCUS RADIODURANS. Hariharan, P. V.; Cerutti, P. A. (Univ. of Florida, Gainesville). Int. J. Radiat. Biol.; 22: No. 3, 301-6(Sep 1972).

Sedimentation techniques in alkaline sucrose gradients were used to study the repair of strand breaks and base damage in γ-irradiated (150 Krads) Micrococcus radiodurans, under aerobic and anoxic conditions. It is suggested that exonucleolytic degradation, starting, predominantly at radiation-induced single-strand breaks, leads to the selective removal of damaged thymine during the first 30 min of incubation after irradiation. On the basis of this model, it would be expected that the rate and extent of removal of damaged thymine depend on the number of unsealed strand breaks available during the early period of incubation. Data to support this theory are presented. The average sedimentation rate of the alkali denatured DNA from unirradiated unincubated cells was greater in anoxic than aerobic conditions. A rapid increase in the sedimentation rate is observed during the first 12 to 13 min of incubation. The presence of chloramphenicol (20 μg/ml) in the incubation medium in sedimentation rate is followed by a slight decrease up to about 100 min. After this period, a steady slow increase in the molecular weight of the DNA was observed and after 3 to 4 hr, the sedimentation profiles were comparable to those of the unirradiated controls. (UK)

56346 WORKING RULES AND APPLICATION TO VARIOUS STARCHES. PROOF FOR IRRADIATION OF STARCH. Berger, G. (CEN de Cadarache, Saint-Paul-les-Durance, France); Rostan Woodhouse, D. Staerke; 24: No. 1, 15-19(1972). (In French).

The test that is proposed for the proof of irradiation of starch is based on the determination of malonaldehyde—which is formed by irradiation—by means of 2-thiobarbituric acid. The study was made on the alteration of the aldehyde content of three starches (maize starch, pregelatinized maize starch, and potato starch) that were irradiated with 400 Krad and stored at different temperatures. If water content of the sample, storage temperature, and duration of storage are known, the original irradiation dose can be calculated by the obtained graphs. These calculations are of variable precision in the specific cases. It is possible to determine the irradiation of maize starch having been stored for three months at 25°C, provided that the irradiation dose was of at least 25 Krad. (GF)

Radiation Effects on Cells (External Source)

Refer also to abstracts 56336 and 57890.

56347 EFFECT OF X-IRRADIATION OF ONE PARTNER ON HYBRID FREQUENCY IN FUSIONS BETWEEN CHINESE HAMSTER CELLS. Harris, Morgan (Univ. of California, Berkeley). J. Cell. Physiol.; 80: No. 1, 119-28(Aug 1972).

Sublines derived from V79 and B150 Chinese hamster cell lack hypoxanthine-guanine phosphoribosyltransferase (HGPRT) and thymidine kinase (TK) respectively. When these strains are cultivated together without virus treatment in HAT medium, hybrid colonies with normal enzymic patterns arise in high frequency. The ratio of proliferating hybrid colonies to the minority cell inoculum in mixed cultures is approximately $^1/_{1000}$. The observation has been used to examine the effect of x-irradiation pretreatment of one cell type on the frequency of hybrid formation in mixed cultures. B150 cells (TK$^-$) were irradiated in monolayer cultures at dose levels of 200–4000r (180 KV, 15 ma). After trypsinization, the irradiated cells were mixed with unirradiated V79 cells (subline 129, HGPRT$^-$) and cultivated in HAT medium. The percent decline in hybrid frequency as a function of x irradiation was compared to the relative decline in viability of x-irradiated B150 cells when assayed in cultures alone. These curves diverged markedly, with the frequency of proliferating hybrids decreasing much less rapidly with radiation dose than survival of B150 cells. By contrast, when B150 cells were subjected to acute heat shock for graded intervals and subsequently mixed with untreated V79-129 cells, both viability of B150 cells and hybrid formation declined at the same rate. Our results suggest that lethally irradiated cells can still fuse with normal cells, and may contribute functional chromosomes to the hybrid karyotype. At limiting doses of x irradiation, this technique may be useful as a means for induced segregation of marker chromosomes. (auth)

56348 SURVIVAL OF CULTURED CHINESE HAMSTER OVARY CELLS FOLLOWING X-IRRADIATION IN MITOSIS. Nagle, William Arthur. Dallas; Univ. of Texas (1972). 116p. University Microfilms Order No. 72-21,416.

Thesis.

Chinese hamster ovary (CHO) cells synchronized in mitosis are more sensitive to x-ray-induced cell killing than cells in the G_1, early-S (ES), or late-S (LS) phases of the cell cycle. Typical survival curve parameters for these cell populations are: mitotic, D_0 = 65–75 rads, n = 2.0–2.5; G_1, D_0 = 100–110 rads, n = 2.5–4.0; ES, about the same as for G_1; LS, D_0 = 120-140 rads, n = 8.0–12.0. The extrapolation number of 2.0-2.5 for mitotic cells is due primarily to the fact that metaphase, anaphase, and telophase cells, although not having completed cytokinesis, nevertheless survive x-irradiation as though they were already two-cell units. Mitotic cells display little or no evidence, based on survival kinetics, for the accumulation of sublethal radiation damage. However, in mitotic cells a type of damage is registered that is expressed later in the subsequent generation of surviving cells as a reduced capacity to accumulate sublethal damage relative to cells of the same age that were not irradiated in mitosis. The amount of reduction in shoulder width for survivors is dependent on the size of the x-ray dose administered to the cells in mitosis. This effect persists at least through most of the DNA synthetic period. During the time interval from LS of the first generation after mitotic irradiation to G_1 of the second generation, surviving cells recover and thereafter again exhibit the full shoulder width characteristic of previously unirradiated cells. Post-irradiation treatment with 2.0 mM hydroxyurea (HU), a potentiator of cell killing, produces similar lethal effects in mitotic and G_1 cells. Thus, qualitatively, the damage or the damage-modification process (repair) that is sensitive to HU is similar in mitotic and G_1 cells. Therefore, the increased x-ray sensitivity probably does not result from a special type of damage induced only in mitotic cells. Special synchrony techniques were used to illustrate that CHO cells at the G_1/S transition period are also very sensitive to x-ray-induced cell killing. Thus, the x-ray age-response of CHO cells shows two minima, in mitosis and at the G_1/S period; G_1 is of intermediate sensitivity, and later, as DNA replication proceeds, cell survival increases steadily to reach a maximum in the LS portion of the cell cycle. (Diss. Abstr.)

56349 RADIATION AND METHOTREXATE EFFECTS ON STATIONARY PHASE CELLS. Berry, R. J.; Huckle, J. M. (Churchill Hospital, Oxford). Brit. J. Radiol.; 45: No. 537, 710-11(Sep 1972).

HeLa S-3oxf. cells were x-irradiated (250 kVp, dose range 0 to 1500 rads), 2 days (log phase) or 9 days (stationary phase) after plating 2×10^5 cells. After irradiation they were counted, replated, and tested for colony forming ability. Results showed that although the plating efficiency of the stationary phase was 24% compared with 65 and 68% for the log phase, there was no apparent difference in post irradiation survival. When the cells were incubated in media containing 0.3 g/ml methotroxate (MTX), a 24 hr exposure left less than 10% exponentially growing HeLa cells intact. The median value of the surviving fraction of stationary phase cells exposed to MTX was 0.81. There was no difference in radiosensitivity in stationary cells exposed or unexposed to MTX. HeLa cells in exponential growth showed a dramatic increase in radiosensitivity after exposure to the same concentration of MTX for the same period. It is suggested that this was due to selection as survivors from the drug, only those cells failing to synthesise DNA during the same period. It is concluded that HeLa cells grown unfed into stationary phase, behave in radiation response, with or without the presence of MTX, as the survivors from exponentially growing cells selected at the G1-S transition by exposure to MTX. (UK)

56350 RADIOPROTECTIVE EFFECT OF PROSTAGLANDIN AND AN INHIBITOR OF CYCLIC NUCLEOTIDE PHOSPHODIESTERASE ON MAMMALIAN CELLS IN CULTURE. Prasad, Kedar N. (Univ. of Colorado, Denver). Int. J. Radiat. Biol.; 22: No. 2, 187-9(Aug 1972).

The radioprotective effect of prostaglandin E1 (10 μg/ml) and 4-(3-butoxy-4-methoxylbenzyl)-2-imidazolidinone (RO 20-1724) was studied in cultures of Chinese hamster ovary cells (CMO).

Both compounds, if given before x irradiation, (505 rads, 75 rads/min), increased the survival of irradiated CMO cells by a factor of approximately 2. When given immediately after irradiation, for a period of 1 to 4 hr, neither compound affected survival. It is suggested that as prostaglandin E1 and RO 20-1724 increase the intracellular level of cyclic AMP, its level may be inversely related to the radiosensitivity of cells. (UK)

56351 EFFECT OF CAFFEINE ON THE SURVIVAL OF U.V.-IRRADIATED DIPLOID AND TETRAPLOID CHINESE-HAMSTER CELLS. Rommelaere, J.; Errera, M. (Univ., Brussels). Int. J. Radiat. Biol.; 22: No. 3, 285-91(Sep 1972).

Post-irradiation treatment with caffeine solutions (2×10^{-3} M/l) reduced the survival of 3 strains of uv irradiated Chinese hamster cells, over a dose range 0 to 600 erg/mm^2. The effect was most noticeable for doses below 200 erg/mm^2 and resulted in the disappearance of the shoulder of the survival curve. In the absence of caffeine the tetraploid synkaryons had the same survival as the diploid cells. In the presence of caffeine, the synkaryons had a lower resistance than the diploid cells. The results are discussed in terms of a recombination-like repair, specifically inhibited by caffeine. (UK)

56352 OXYGEN EQUILIBRATION PROBLEMS IN THE DETERMINATION OF K FOR HeLa S_3 (OXF). Moore, J. L.; Pritchard, J. A. V.; Smith, C. W. (Velindre Hospital, Whitchurch, Eng.). Int. J. Radiat. Biol.; 22: No. 2, 149-58(Aug 1972).

HeLa S_3 (OXF) cells attached to polystyrene Petri dishes could not be used to investigate radiosensitivity at low oxygen concentrations because of the oxygen dissolved in the polystyrene matrix. An estimation of K (the oxygen concentration when the relative radiosensitivity (R) is (M + 1)/2) in the formula $R_1 = (S_{max}/S) = \{M([O] + K)\}/\{M[O] + K\}$ was made for mammalian cells attached to glass Petri dishes, but it was dependent on various factors, the most important being the depth of medium over the cells at the time of irradiation. Oxygen equilibration was via diffusion, therefore a correction for the oxygen concentration differences between the gas phase and the cell was made; a K value of 12 μ moles/l was obtained which is appreciably higher than other reported values. Although an estimate of the errors on this value was not made, all measurements fell within the range 8.5 to 17.5 μ moles/l. (auth)

56353 RADIOSENSITIZATION OF HYPOXIC CELLS IN VITRO: A WATER-SOLUBLE DERIVATIVE OF PARANITROACETOPHENONE. Adams, G. E.; Asquith, J. C.; Watts, M. E.; Smithen, C. E. (Mount Vernon Hospital, Northwood, Eng.). Nature (London) New Biol.; 239: No. 88, 23-4(6 Sep 1972).

A comparison was made of the radiosensitization properties of paranitroacetophenone (PNAP) and its more water soluble derivative, p-nitro-3-dimethylamino-propriophenone HCL (NDPP). The radiosensitizing effect of NDPP on hypoxic bacteria (Serratia marcescens) suspensions was studied over a concentration range of 0.1 to 20 mM and a γ radiation dose range of 0 to 50 krad. Some sensitization was detected at 0.1 mM and at 20 mM, the enhancement ratio (ER) was equal to that of oxygen. When 100% O_2 was present during irradiation, there was very little effect, even at the highest concentration. The maximum ER obtained with PNAP at its solubility limit of ~3 mM was 2.7 compared with 3.8 for NDPP at the same concentration. During observations of hypoxic Chinese hamster lung cells, over a dose range 0 to 3000 rad, the maximum effect (ER 1.7) obtained with PNAP was obtained at concentrations in excess of 400 μM, whereas a similar effect was observed at 10 μM NDPP, and the maximum ER observed was 2.1. In the case of the mammalian cells, the effect of the compound in pure O_2 was significant, but very small. (UK)

56354 EFFECTS OF X-RAY IRRADIATION ON DEOXYRIBONUCLEOTIDE AND DNA SYNTHESIS IN CULTURED MOUSE EMBRYO CELLS. **Slaby, Ivan; Skoog, Lambert; Thelander, Lars (Karolinska Institutet, Stockholm). Eur. J. Biochem.; 21: No. 2, 279-84(1971).**

Mouse embryo cell cultures in the G_1 phase or the S phase were x-irradiated at doses that resulted in a depression of DNA synthesis. Ribonucleotide reductase and thymidine binase activities, as well as the pools of thymidine triphosphate and dATP, were measured at different times following irradiation. Following exposure in the G_1 phase, the activity of ribonucleotide reductase (but not of thymidine kinase) and the pool sizes of both deoxyribonucleotides were depressed in parallel with DNA synthesis, as compared to the controls. However, an immediate small increase in the pool sizes of the deoxyribonucleotides was observed following exposure in the S phase. Ribonucleotide reductase activity was not affected at early times following exposure. The decrease in DNA synthesis observed following exposure was apparently not the result of a depletion of deoxyribonucleotide pools. (E.R.B.)

Radiation Effects on Microorganisms (External Source)

Refer also to abstracts 56329, 56353, 56407, and 56454.

56355 (AECL–4213) BIOLOGY AND HEALTH PHYSICS DIVISION PROGRESS REPORT, JANUARY 1–MARCH 31, 1972. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jun 1972. 63p. (PR-B–93). Dep. NTIS (U. S. Sales Only). AECL $2.00.

Separate abstracts were prepared for four sections of this report. (H.L.W.)

56356 (AECL–4213, pp 7-23) BIOLOGY. Jun 1972.

Research in biochemistry and molecular biology includes the following projects: comparison of RNA molecules in animal cells by oligonucleotide analysis; study of rapidly sedimenting, heterogeneous RNA in animal and yeast cells; search for genes corresponding to poly A sequences found in messenger and heterogeneous nuclear RNA; role of cell membrane in radioinduced degradation of DNA in Escherichia coli; effects of radiosensitizing agents on E. coli; radiation protection of rat thymus cells; induction of leukemia in rats; nucleases of Micrococcus radiodurans; and repair of radiation damage in M. radiodurans and Schizosaccharomyces pombe. Research in genetics, development, and population studies included the following projects: genetic control of radiosensitivity in S. pombe; replicating instabilities in S. pombe; liquid holding recovery and spontaneous cell death in the normal and radiosensitive strains of S. pombe; the effect of dark repair inhibitors on growth of irradiated S. pombe cells; superinfection exclusion by bacteriophage T4; polyacrylamide gel electrophoresis of phage T4; radiation genetics of Dahlbominus; radiation injury in Rhodnius; and radiation studies on biting flies. (H.L.W.)

56357 (AERE-R–7200) PYROGENIC ACTIVITY OF BACTERIA DRIED ONTO GLASS OR PLASTIC SURFACES AND STERILISED BY HEAT OR GAMMA-RADIATION. Winsley, B. E. (Atomic Energy Research Establishment, Harwell (England)). Aug 1972. 7p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

Inocula of over 10^6 bacterial cells, dried onto the inner surfaces of glass or polystyrene hypodermic syringes and sterilized by heat or γ radiation, were tested for pyrogenic activity by the British Pharmacopoeia (1968) test. Bacterial species which might possibly contaminate commercially manufactured syringes were selected. Only Escherichia coli cells provoked a significant pyrogenic response. (auth)

56358 TEMPERATURE DEPENDENCE OF THE SURVIVAL OF U.V.-IRRADIATED HERPES VIRUS. Lytle, C. David (Environmental Protection Agency, Rockville, Md.). Int. J. Radiat. Biol.; 22: No. 2, 175-7(Aug 1972).

Survival curves were obtained for ultraviolet irradiated Herpes simplex virus (MP strain), when infected cultures were incubated at 24°C, 37°C or 42°C for the first 20 hr after virus adsorption, after which the temperature was 37°C for the remainder of the virus assay. Irradiation was over a range of 0 to 4000 erg/mm^2. The second component of the survival curves showed definite though not large differences in slope, with the extrapolated values at zero dose ~ equal for all temperatures. There was an apparent increase in plaque forming ability at 42°C with low u.v. exposures (below 1500 erg/mm^2). (UK)

56359 MICROBIOLOGICAL PROBLEMS IN THE PRESERVATION OF FOOD. Schmidt-Lorenz, W. (Univ., Karlsruhe, Ger.). Deut. Lebensm.-Rundsch.; 67: No. 11, 409-12(1971). (In German).

Within the framework of a review of the microbiological problems arising in connection with the preservation of food, i.e. of fully and semi-sterilized products, and of modern procedures for the preservation of food, the author discusses the inhibition of microbes by ionizing radiation and the present state of development of this method. Ionizing irradiation will be applied in future mainly for pasteurizing foodstuffs by inhibiting the growth of vegetative cells of unwholesome bacteria, whereas for the inhibition of bacterial spores, just as for the thermal sterilization, the doses to be applied for this purpose are so high that they will produce undesirable changes in the irradiated material. The spores of the most dangerous bacterium in food, Clostridium botulinum, belong to the most radioresistant species and will thus not allow an efficient preservation of foodstuffs by ionizing radiation within the foreseeable future. (GF)

56360 OH RADICALS IN RADIATION SENSITIZATION. Powers, E. L.; Richmond, R. C.; Simic, M. (Univ. of Texas, Austin). Nature (London) New Biol.; 238: No. 87, 260-1 (30 Aug 1972).

The inactivation constant k for x-irradiated aqueous suspensions of Bacillus megaterium spores was determined with 50 kV x-rays over a dose range 0 to 500 Krad at pH 6.0 to 7.0. The following conditions were studied: the effect of NO_3^- concentration on k in anoxic conditions; the effect of isobutanol concentration on k at 10^{-2} M NO_3^-; the effect of t-butanol concentration on k at 10^{-2} M NO_3^-; the effect of NO_3^- concentration on k at 1.3×10^{-3} M O_2. The value of k depended on NO_3^- concentration, reaching a maximum at $\sim 7 \times 10^{-3}$ M NO_3^-. At higher concentrations up to 1 M NO_3^- a small decrease was observed. When specific OH scavengers were added to suspensions maximally sensitized by NO_3^-, a concentration dependent reduction of the sensitization was observed. Both isobutanol and t-butanol reduced the sensitizing effect near to zero, isobutanol being more effective at concentrations below 10^{-3} M. (UK)

56361 CHROMOSOMAL RECOMBINATION IN HAEMOPHILUS INFLUENZAE. Stuy, Johan H.; Hoffmann, Joan F.; Duket, Lea H. (Florida State Univ., Tallahassee). Contract AT(40-1)-3885. Genetics; 71: No. 4, 507-20(Aug 1972).

Haemophilus influenzae cultures doubly lysogenic for defective phage HP1, with a prophage marker sequence +b+/a+c, always contained some free wild-type phage. Single ultraviolet-irradiated cells produced either no wild-type phage or large numbers of them. This suggested that the phage was not released by the original double lysogen but by internal recombinants, i.e., by double lysogens with altered prophage marker sequence such as +++/abc or +b+/++c. Thirty-one wild-type phage-producing clones have been isolated independently from cultures of this double lysogen and identified. They fell in five classes. Two classes, still possessing all three prophage markers, can be explained by Campbell's (1963) prophage recombination model. The other classes had lost one or more markers. They can be explained by interchromosomal double-strand DNA breakage and rejoining. A single-DNA-strand gene conversion model is discussed in view of the fact that genetic transformation involves single-DNA-strand exchanges. A number of potentially interesting mutants were analyzed of which only the derivatives of rec1 mutant DB117 were incapable of internal recombination. (auth)

56362 HOST-CELL REACTIVATION IN MAMMALIAN CELLS. II. SURVIVAL OF HERPES SIMPLEX VIRUS AND VACCINIA VIRUS IN NORMAL HUMAN AND XERODERMA PIGMENTOSUM CELLS. Lytle, C. David; Aaronson, Stuart A.; Harvey, Estelle (Environmental Protection Agency, Rockville, Md.). Int. J. Radiat. Biol.; 22: No. 2, 159-65(Aug 1972).

Human cells from normal and xeroderma pigmentation (XP) patients were used to investigate host-cell reactivation (HCR) of two animal viruses possessing double-stranded DNA. Lower than normal survival of uv-irradiated Herpes virus in XP cells implied that HCR was present in normal cells. HCR occurred to equal extents in both components of the survival curve (contrary to the case for bacteriophage where HCR is manifested primarily in the second component). The amount of HCR was quantitatively different from that previously reported for the tumor virus SV_{40}. The XP cells provided normal levels of survival for uv-irradiated Vaccinia virus. Little, if any, HCR was apparent for x-irradiated Herpes simplex virus. Ultraviolet irradiation was carried out over a dose range of 0 to 1750 erg/mm^2 and x irradiation over a range of 0 to 9.5×10^5 rads. (auth)

56363 HOST-CELL REACTIVATION IN MAMMALIAN CELLS. III. EFFECT OF CAFFEINE ON HERPES VIRUS SURVIVAL. Lytle, C. David (Environmental Protection Agency, Rockville, Md.). Int. J. Radiat. Biol.; 22: No. 2, 167-74(Aug 1972).

Survival curves of uv-irradiated Herpes simplex virus over a dose range of 0 to 5000 erg/mm^2 were determined in the presence of different caffeine concentrations. At low concentrations (which do not greatly reduce virus plaque-forming ability), the first component of the survival curves was only slightly affected, whereas the slope of the second component was increased. At higher concentrations, the slope of the first component increased and the fraction of infected cells expressing the second component decreased. Since repair replication in uv-irradiated cells is not reduced by caffeine, it was suggested that the caffeine sensitivity of irradiated Herpes virus indicated a second recovery mechanism for the virus. The caffeine sensitivity decreased at the time viral DNA synthesis normally commences, implying a correlation of caffeine-sensitive uv recovery with viral DNA synthesis. (auth)

56364 H_2O_2 AND .OH RADICALS IN RADIATION INACTIVATION OF BACTERIAL SPORES. Powers, E. L.; Cross, M.; Simic, M. (Univ. of Texas, Austin)# Int. J. Radiat. Biol.; 22: No. 3, 237-43(Sep 1972).

Suspensions of Bacillus megaterium spores, when irradiated in the presence of N_2O and limiting concentrations of ethanol, had produced bi-phasic response curves with the high-dose line showing increased sensitivity. Experiments correlating sensitivity to concentrations of H_2O_2, between 1×10^{-3} M and 1×10^{-5} M H_2O_2, implicated this chemical species as one sensitizing agent over a range 0 to 600 Krad. H_2O_2 was not sensitizing, however, in the absence of .OH, suggesting that two actions involving both species must take place for inactivation to occur. A chemical mechanism competent to explain these facts is presented. Sensitization seen in O_2-saturated solutions could not be explained by this mechanism. (auth)

56365 MUTAGENESIS BY TRITIUM: DECAYS ORIGINATING FROM GROWTH AND STORAGE IN TRITIATED WATER AND FROM CHEMOSTATIC GROWTH IN THE PRESENCE OF TRITIATED NUCLEIC ACID PRECURSORS. Sands, Jeffrey A.; Snipes, Wallace; Person, Stanley (Pennsylvania State Univ., University Park). Int. J. Radiat. Biol.; 22: No. 2, 197-202(Aug 1972).

Escherichia coli ww cultures were assayed for loss of colony forming ability and reversion to arginine independence, as a function of storage time when stored in ^3H_2O. The efficiencies of inactivation and revertant production were nearly the same as those for decays originating from tritium labelled protein (^{3}H-serine). In a second experiment, reversion frequencies were measured for cells grown continuously in a chemostat in the presence of ^{3}H-uracil-5, ^{3}H-uracil-6 or ^{3}H-thymidine-methyl. The observed frequencies, accumulated over a period of 3 to 7 days, were very similar to those previously reported for the same compounds, when the same strain was labelled and stored under non-growth conditions. (UK)

56366 SENSITIZATION OF ASPERGILLUS FLAVUS SPORES TO GAMMA RADIATION BY HALOGENS. Mohyuddin, Mirza; Skoropad, W. P. (Univ. of Alberta, Edmonton). Can. J. Bot.; 50: No. 7, 1431-4(Jul 1972).

Survival curves for spores of Aspergillus flavus Link var. columnaris Raper and Fennel were obtained after their irradiation with gamma rays in the presence of Na^+, K^+, and Ca^{2+} halogens. Halogens of Na^+ and K^+ sensitized the spores to the radiation and enhanced sensitization occurred as the dose of radiation was increased. Halogens of Ca^{2+} protected the spores against a radiation dose of 25 krad but at higher doses although $CaCl_2$ was protective, $CaBr_2$ and CaI_2 were radiosensitizers, with CaI_2 the most efficient radiosensitizer. (auth)

56367 INFLUENCE OF GAMMA RADIATION (COBALT 60) ON CULTURES OF A CHLOROPHYTE, DUNALIELLA BIOCULATA. Saraiva, M. C. (Institut Oceanographique, Paris). Mar. Biol.; 15: No. 1, 74-80(Jul 1972). (In French).

The influence of gamma radiation on the rate of cell division and the amount of chlorophyll a per cell was studied for Dunaliella bioculata Butcher, 1959 cultures. A decrease in the cell-division rate and an increase of chlorophyll a per cell were observed. (auth)

56368 BIOLOGICAL AND ELECTRON MICROSCOPIC CHANGES IN GAMMA RADIATED CRYPTOCOCCUS NEOFORMANS. Dembitzer, H. M.; Buza, I.; Reiss, F. (Montefiore Hospital, Bronx, N. Y.). Mycopathol. Mycol. Appl.; 47: No. 3, 307-15(1972).

Samples of Cryptococcus neoformans were irradiated with various doses of gamma radiation. The relatively low doses, 1 to 5×10^4 rads, resulted in no obvious effect on the fine structure of the cells but did seriously prevent a large proportion of the organisms from reproducing on agar. When subjected to doses of 1×10^6 rads virtually all the organisms lost their ability to reproduce. When such samples were examined in the electron microscope, almost all the cells were found to have lost their capsules whereas other aspects of their fine structure remained apparently normal. (auth)

56369 PRELIMINARY STUDY OF EFFECTS OF GAMMA IRRADIATION ON GROWTH OF FUNGI. Tardieux, P.; Perea-Dallos, M.; Falcou, J.; Hervecottu, Y. (Institut Pasteur, Paris). Agrochimica; 16: No. 1-2, 83-98(1971-1972). (In French).

Ten species of fungi were pointed out as the most representative of Mediterranean soil, on the basis of their regular presence in the samples taken at different seasons and the number of isolates from each sample. They were identified and exposed to a range of γ rays. The sensitivity of these species of fungi to γ rays can be characterized by two parameters that can be calculated from the doses inactivating 50% and 90% of the living mass. Moreover, it was shown that the determination of these parameters provides a suitable method to study the rate of growth of mycelial microcolonies within the time following the germination. It was observed from this method that in condition of favorable media, the growth of mycelium is capable of compensating the inactivation by irradiation at the higher doses. In a sterilized soil sample re-inoculated simultaneously by several species of fungi and irradiated during a certain time period, it was observed that a modification of equilibrium following the irradiation depends more on the rate of growth of each species and of its ability for recolonization of the medium than on its radiation sensitivity. It can be deduced that the direct effect to be expected from a chronic irradiation in natural conditions will be a selection of rapidly growing species with a high ability for recolonization rather than a selection of radioresistant species. (auth)

Radiation Effects on Plants (External Source)

Refer also to abstracts 56337 and 56504.

56370 (EUR-4810(Vol.2), pp 789-805) EXPERIMENTAL VERIFICATION ON ESCHERICHIA COLI K12 OF CERTAIN RESULTS OF THE GENERAL THEORY. Passe, Suzanne. (In French).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

A study was conducted to verify experimentally a theory on the evolution of molecular systems exposed to radiation in cases where the system is linear. A discussion is presented of mathematical aspects of the theory and experiments are described to determine the effects of ultraviolet radiation on survival of Escherichia coli in a buffered medium. Results are presented in the form of survival curves following continuous and fractionated irradiation for periods up to 23 hrs after the cessation of irradiation. It was concluded that the theory was verified experimentally. The bacteria exhibited a linear behavior in a buffered medium. It is more difficult to apply the linear hypothesis in the case of microorganisms in a nutritive medium or in the case of mammalian cells in vivo or in vitro. (H.L.W.)

56371 (NP-19439) GERMINATION OF γ-IRRADIATED AND NON-IRRADIATED SEEDS OF PINUS SILVESTRIS UNDER VARIOUS TEMPERATURE CONDITIONS. Lindgren, Dag; Nikolic, Djordje; Simak, Milan (Royal Coll. of Forestry, Stockholm (Sweden). Dept. of Forest Genetics). 1972. 23p. Dep. NTIS (U. S. Sales Only).

Seeds of Pinus silvestris (four provenances) were γ-irradiated with different doses. The germination was tested during two weeks at 15°, 20°, and 30°C. The temperature was then maintained at 20°C for a further two weeks in all three series. The germination after two weeks was more or less complete at 20°C except for seeds exposed to high doses, but depressed at 15° and 30°C. When the temperature was changed after two weeks from 15° or 30° to 20°C, a considerable late germination took place, bringing the germination closer to that at 20°C. The radiation response of germination was modified by the germination temperature. The radiosensitivity was lower at 20° than at 15° or 30°C. A slight difference in radiosensitivity between provenances was found. (auth)

56372 EFFECT OF X-RAY IRRADIATION ON FLOWERING RESPONSE OF SOME CROP PLANTS. Bhargava, S. C.; Sirohi, G. S. (Indian Agricultural Research Inst., New Delhi). Indian J. Agr. Sci.; 42: No. 5, 389-92(May 1972).

A study was made of the effect of acute x-ray irradiation treatments at pre-sowing stage on the flowering response of biloxi soybean (Glycine max (L.) Merr.), an obligate short-day plant (SDP), and on the growth and flowering of 2 species of a facultative SDP sorghum and their hybrid. Exposures of 250, 500, 1,000, and 2,000 R to seeds caused marked stimulation of floral initiation in biloxi soybean plants, but this took place only under SD-inductive conditions. In sorghum, the hybrid seeds were more sensitive to x-ray exposure than their parental lines, especially in flowering. The results are interpreted and discussed in terms of interference by x-ray irradiation on the chain of reactions and their rates that are responsible for floral expression. (auth)

56373 RECIPROCAL CROSSES BETWEEN M_1 AND MOTHER PLANTS AND THEIR EFFECTS IN TOMATO. Monti, L. M. (CNEN, Rome). Z. Pflanzenzuecht.; 66: No. 4, 293-300(1971). (RT/BIO(72)24).

To clarify the extent to which gamete sterility of M_1 plants influences the isolation of the induced mutations, 38 M_1 plants of the tomato variety Moneymaker deriving from simultaneous irradiation of both male and female gametes with 3000 R of gamma rays were crossed with 38 control plants in reciprocal crosses: $M_1 \times$ Control ($M_1 \times C$) and Control $\times M_1$ ($C \times M_1$). The 38 M_1 plants were also selfed. Analysis of chlorophyll and morphological mutation performed at the seedling stage in M_2, M_3, and in the F_2 of the reciprocal crosses, showed that nine M_1 plants were heterozygous for an induced mutation, but only five of these segregated for mutated plants on all the analyzed generations. Of the mutations occurring in the other 4 M_1 plants, one did not appear in M_2, one was not detected in the F_2 from $C \times M_1$, and the remaining two appeared only in the F_2 from $M_1 \times C$. The absence of the mutations in M_2 and in the F_2 from $C \times M_1$ was explained on the assumption of the occurrence in M_1 of selection against the M_1 mutated pollen grains (haplontic selection), while the mutated female gametes were presumed to have a greater ability to withstand the genetic damage induced by the mutagenic treatment. The detection of mutations only in the F_2 from $M_1 \times C$ can be explained by the presence of factors linked with the induced mutations and affecting pollen viability, with a lower penetrance in the $M_1 \times C$ plants; also the induction of chromosome aberrations determining the failure of the M_2 zygotes heterozygous for the mutation (that could have been eliminated in the cross $M_1 \times C$) can be hypothesized. The results indicate the possibility of a better exploitation of the induced variability by utilizing M_1 plants as female parents in backcrosses or in crosses with other varieties. (auth)

56374 COMPARATIVE STUDY OF THE EFFECTS OF X IRRADIATION AND ETHYLENIMINE ON THE M_1 GENERATION OF COMMON WHEAT. Amirbekyan. V. A. Biol. Zh. Arm.; 24: No. 7, 50-5(Jul 1971). (In Armenian).

The effects of x rays and ethylenimine on four varieties of soft wheat were investigated. Dry seed was subjected to doses of 5 to 20 kR and/or 18 hr soaking in concentrations of ethylenimine of 0.02 or 0.05%. Sensitivity to these agents, and the mutation rate both varied significantly among the four varieties of wheat; sensitivity and mutation rate could not be correlated. Different radiation doses and concentrations of ethylenimine affected growth and plant development differently for each variety. (tr-auth)

56375 EFFECTS OF IONIZING RADIATION ON SPROUT INHIBITION AND NUTRITIVE VALUE OF POTATO TUBERS. Lee, Mie Soon; Kim, Hong Lyour. Han'guk Sikp'um Kwahakhoe Chi; 4: No. 1, 29-35(1972).

Effects of various dosages of gamma ray ranging from 0 to 16 krad on sprout inhibition and nutritive value of potato tubers were investigated with the Irish Cobbler variety. Sprout growth was gradually suppressed with increasing dosage, and completely inhibited with 16 krad treatment. Under this optimum dosage, weight loss of tubers was markedly reduced and tubers kept firm throughout 2 month storage period. Irradiation had no adverse effects on the cooking quality of potato tubers. Moisture content of stored potato tubers was shown to be in inverse proportion to sprout growth. Tubers treated with 16 krad tended to contain somewhat higher percentage of total carbohydrate than those treated with lower dosages. Significantly larger amounts of ascorbic acid were retained in 8 and 16 krad treatments than in 0 and 2 krad treatments. (Korean Sci. Abstr.)

56376 APPLICATION OF GAMMA-RAY IRRADIATION OF SEED BEFORE SOWING FOR INCREASE OF AGRICULTURAL YIELD. Beryosina, N. M. (Institut of Biophysics, Moscow). Isotopenpraxis; 8: No. 4, 153-4(Apr 1972). (In German).

The use of γ irradiation of seeds as a means for enhancing agricultural yields is surveyed. Included are production technical experiments of several years duration. These field studies concern potatoes, sugar beets, corn, cabbage, carrots, and radishes. Doses ranging from 100 to 4000 rads were applied. The enhancement of yield for various seeds ranged from 10 to 30%. For irradiation of large amounts of agricultural seeds, the institute for organic chemistry of the USSR academy of sciences developed the transportable γ installation Kolos. Between 1968 and 1970, large areas were planted with irradiated seeds. Data will be submitted to the technical advisory committee of the ministry for agriculture of the USSR. (H.B.G.)

56377 EFFECT OF RADIATION ON THE PRODUCTIVITY AND POLYPHENOL COMPOSITION OF BUCKWHEAT. Karabanov, I. A.; Veremeichik, V. E. (Gomel State Univ., USSR). Dokl. Akad. Nauk SSSR; 203: No. 2, 488-90(11 Mar 1972). (In Russian).

The effect of the gamma irradiation of seeds on the productivity of buckwheat plants and on the content in their organs of biologically active polyphenols was studied. Three groups of buckwheat seeds received 10, 20, and 30 kR of ^{60}Co γ radiation, respectively, and then were sown in sandy loam. The first two groups grew slowly to maturity, but the 30-kR group withered. The effect of 10 kR was to increase the weight of seed, stem, and roots, i.e., to raise the productivity, but to decrease the content of bio-active polyphenols. The dose of 20 kR produced many underdeveloped seed, and also reduced the polyphenol content. (K.S.W.)

56378 SELF-INCOMPATIBILITY IN BASIC AND APPLIED RESEARCHES WITH HIGHER PLANTS. De Nettancourt, D. (CNEN, Rome). Genet. Agr.; 26: No. 1-2, 163-216(30 Jun 1972).

A review is presented of the characteristics of self-incompatibility mechanisms and it is demonstrated that the S-system is exceptionally well suited for both basic and applied research with multicellular higher plants. The genetic structure and function of the S-locus in gametophytic monofactorial species are discussed. The advantages and limitations of the S-system in basic research are described and basic studies on the S-locus in genetics and mutagenesis are discussed. Studies on radiation protection are reviewed with regard to minimum radiation levels below which the genetic risk can be considered as negligible. Some uses of the S-system in radiobiological investigations are as follows: the stage-sensitivity relationship; variations in the radiation responses of different alleles; interallelic dependence on mutability; and apparent incapacity of radiation to induce constructive mutations. Breeding systems in self-incompatible crops are also reviewed. (H.L.W.)

56379 MUTATIONS INDUCED BY IRRADIATION OF OLIVE ROOTED CUTTINGS. Donini, B. (CNEN, Rome); Roselli, G. Genet. Agr.; 26: No. 1-2, 149-60(30 Jun 1972). (In Italian).

Rooted cuttings of olive trees, variety Ascolana and Moraiolo, 411 and 451 respectively, were irradiated, at dormant stage of the buds, in the gamma field (^{60}Co source) at a total exposure of 4000 R (exposure rate 250 R/h). The treated plantlets and the controls were transplanted in the field and the primary effects in the V_1 have been observed. Somatic mutations were isolated in V_2 shoots which originated along the V_1 shoot by successive cutting back. The frequency of chlorophyll and morphological mutations is 14% for Ascolana and 4% for Moraiolo in the basal region and 7.3% and 0.24 in the median and upper region of the V_1 shoot. The higher mutation frequency observed in the shoots of the basal region of the V_1 may be explained since the primordia of such shoots were already present when the bud was irradiated. The different frequency of mutations between Ascolana and Moraiolo may be considered as a different heterozygosity of the two cultivars. Among the morphological mutations isolated, those showing a shortening of shoot internodes have been propagated with the purpose of obtaining spur types which might be of great agronomical importance in this species. (auth)

56380 MUTANTS OF AGRONOMIC VALUE INDUCED IN THE TOMATO VARIETY MONEYMAKER BY GAMETE IRRADIATIONS. Monti, L. M. (CNEN, Rome). Genet. Agr.; 26: No. 1-2, 111-18(30 Jun 1972). (In Italian).

M_2 mutation analysis has been carried out on tomato seedlings and mature plants (var. Moneymaker) obtained after γ-ray and fast neutron irradiation of both gametes. Nineteen mutations (30% of the total number) which had not been detected at the seedling stage were found in the adult individuals. A number of the mutations observed appears to be economically interesting and this is particularly the case of brown seed types and of a monogenic and recessive brachytic mutant (M 86). The brown seed mutants can be utilized as markers of hybrid seeds, while the brachytic mutant can be useful for intensive cultivation. The M 86 mutant is in fact approximately 35 cm in height and does not need tutoring. Spacing preliminary experiments (2.38 and 3.75 plants for square meter) performed at the Casaccia indicates that the yield of M 86 approximates that of the control line under conditions of close spacing. (auth)

56381 CHROMOSOME AND CHROMATID ABERRATIONS RESULTING FROM IRRADIATION OF G_1 PHASE OF ALLIUM CEPA SEED CELLS. Dubinin, N. P.; Nemtseva, L. S. (Inst. of General Genetics, Moscow). Tsitol. Genet.; 6: No. 2, 99-102(1972). (In Russian).

The exposure to different doses of ^{137}Cs gamma rays of Allium cepa air-dry (13.3% water), superdry (0.3% water), and saturated seeds having 98% cells of embryonic radicles in G_1 and 2% in G_2 results in chromosome and chromatid aberrations. After irradiating air-dry and superdry seeds, chromatid bridges in anaphase of the first mitosis form 25% from the total number of the bridges, and after irradiating of saturated seeds—only 8.7%. This results from the appearance in chromosomes of two types of potential lesions: short-lived ones becoming chromosome aberations in the same phase (G_1) at which they arose and long-lived ones remaining till the synthetic phase (S) and turning into chromatid aberrations. During irradiation of air-dry and dry seeds long-lived lesions arise in a greater quantity than during irradiation of saturated seeds. (auth)

56382 EFFECTS OF IRRADIATED FOOD ON THE ADULT SURVIVAL AND REPRODUCTION OF RHYZOPERTHA DOMINICA (F) (COLEOPTERA, BOSTRICHIDAE). Singh, Harpal; Liles, J. N. (Univ. of Tennessee, Knoxville). J. Stored Prod. Res.; 8: No. 2, 155-7(1972).

Newly emerged adults of the lesser grain borer were fed wheat grains irradiated with ^{60}Co gamma rays at a dose rate of 4200 R/min. There were three replications in each of the four treatments and each replication consisted of 20 pairs. A significant reduction in survival of beetles fed on 320 kR irradiated food was noted, but no reduction in survival was noted in beetles fed on 80 kR irradiated food. A suppression of egg production and low egg viability were observed in beetles fed irradiated food; results were more pronounced in beetles fed on 320 kR than those fed on 80 kR treated food. (H.L.W.)

56383 PRODUCTION OF RADIOMUTANTS OF WHEAT RESISTANT TO HARD RUST. Babayan, V. O.; Oganesyan, V. A. (Lab. of Radiation Genetics, Erevan). Dokl. Akad. Nauk Arm. SSR; 53: No. 5, 269-72(1971). (In Russian).

The use of unripe wheat seed as a possible source of rust-resistant radiomutants was explored. Wheat seed of various degrees of ripeness (collected 7, 14, 28, and 35 fully ripe days after flowering) were divided into three groups for irradiation dosages: 1,800 R just before harvesting, 20 kR just before seeding, and controls (no irradiation). The data indicated that most resistant mutants were obtained from the natural mutation of plants resulting from seed at the beginning of embryogenesis (7 to 14 day-old seed). (K.S.W.)

56384 INDUCED MUTAGENESIS IN WHEAT SEED OF DIFFERENT AGES. Avakyan, D. O.; Babayan, V. O. (Lab. of Radiation Genetics, Erevan). Dokl. Akad. Nauk Arm. SSR; 53: No. 5, 279-82(1971). (In Russian).

Mutagenesis in unripe wheat seed after x irradiation was investigated. Wheat heads were collected 5, 15, 25, and 40 days after flowering and given 1,800 R doses. The mitotic activity of the seed decreased with decreasing age of the seed. Unripe seed possessed somewhat depressed mitotic activity and a high mutation rate. Irradiation with doses of 1,800 R intensified the depression of mitosis and sharply raised the mutation level of unripe seed. (K.S.W.)

56385 COMBINED ACTION OF RADIATION AND ETHYLENIMINE ON DIFFERENT VARIETIES OF WHEAT. Avakyan, V. A.; Amirbekyan, V. A. (Lab. of Induced Plant Mutagenesis, Erevan). Dokl. Akad. Nauk Arm. SSR; 53: No. 5, 273-8(1971). (In Russian).

Four varieties of wheat were subjected to the combined effects of x radiation and ethylenimine. A portion of seed that was given a dose of 10 kR was treated with 0.02% solution of ethylenimine for 18 hr. Unirradiated seed were also given the chemical treatment. Radiation plus the chemical mutagen lowered the survival rate of two wheat varieties in comparison with radiation alone. Frequency of morphological changes indicated that each variety of wheat was characterized by its own mutation rate. (K.S.W.)

56386 INVESTIGATION OF MEIOSIS IN IRRADIATED PLANTS AND IN PLANTS GROWN IN SOILS WITH A HIGH URANIUM AND RADIUM CONTENT. Vavilov, P. P.; Eiges, N. S.; Popova, O. N.; Kodaneva, R. P. pp 103-12 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The cytological picture of meiosis was studied in the anthers of barley and winter rye growing under conditions of chronic gamma irradiation (0.1 R per 24 hrs), and in soils with a high uranium and radium content (up to n. 10^{-3} and n. 10^{-7}% respectively). It was found that prolonged gamma irradiation with small doses stimulates crossing over and favors a regular pairing of chromosomes. At the same time data obtained show that radium and uranium taken up by plants depress crossing over and lead to some chromosomal aberrations (increase in the number of fragments and lagging chromosomes). (auth)

56387 LUMINESCENCE OF CELLS INDUCED BY X RAYS UNDER HIGH OXYGEN PRESSURES. Avakyan, Ts. M.; Adzhyan, N. S.; Stepanyan, L. G. (Erevan Physical Inst.). Biol. Zh. Arm.; 24: No. 6, 33-8(Jun 1971). (In Russian).

Five-day old pea roots were irradiated with x rays from 500 R to 5 kR; controls were kept under N_2 and experimental samples were blanketed by 0.2 to 9 atmospheres of O_2. The intensity of chemoluminescence was measured. The roots in N_2 exhibited a fall in the luminescent intensity; those in O_2 were luminescent to an extent roughly proportional to the radiation dose received. The results are discussed in terms of the growing tissue and a chain reaction of oxidation. (K.S.W.)

56388 SEED RADIOSENSITIVITY: WIDE RANGE IN OXYGEN-ENHANCEMENT RATIO AFTER GAMMA-IRRADIATION OF EIGHT SPECIES. Conger, B. V.; Constantin, M. J.; Carabia, J. V. (Univ. of Tennessee, Knoxville). Int. J. Radiat. Biol.; 22: No. 3, 225-35(Sep 1972).

A study was made to determine the oxygen effect after ^{60}Co γ-radiation of dry seeds from 8 species of higher plants which differed in radiosensitivity and nuclear and chromosome volume. Seeds of barley, rice, cucumber, fescue, lettuce, alfalfa, radish and onion were dried to a water content of between 1 and 3% by storage over $CaSO_4$ under vacuum. The seeds in vacuo in glass tubes were then exposed to ^{60}Co γ-radiation over a range 0 to 240 Krad. After irradiation, the seeds were soaked in either oxygen- or nitrogen-bubbled water at 0^0c ~ 18 hr. The oxygen-enhancement ratio (o.e.r.) measured at D_{50} for seedling growth reduction (dry weight/plant) ranged from 1.3 for onion to 16.7 for rice. The wide range in oxygen-sensitivity among species was not related to nuclear volume or interphase chromosome volume, the relative radiosensitivity of the species or any taxonomic criteria. The radiation damage appeared to be enhanced more by oxygen in starchy than in oily seeds. Seed radiosensitivity was related to nuclear and interphase chromosome volumes when seeds were soaked in nitrogen-bubbled water: however, the relationship did not exist for seeds soaked in oxygen-bubbled water. (auth)

56389 RADIATION-INDUCED DIVISION DELAY IN DICTYOSTELIUM DISCOIDEUM: RELATION TO SURVIVAL IN RESISTANT AND SENSITIVE STRAINS. Cleveland, R. F.; Deering, R. A. (Pennsylvania State Univ., University Park). Int. J. Radiat. Biol.; 22: No. 3, 245-56(Sep 1972).

It is pointed out that vegetative amoeboid cells of the cellular slime mould, Dictyostelium discoideum NC-4, are very resistant to gamma-radiation. Mutant strains have been isolated which are significantly more radiosensitive. Studies were conducted to measure division delays and other growth responses after irradiation of strain NC-4 and two mutant strains, with doses of γ-radiation up to 180 Krads. Some division of non-surviving (non-colony-forming) cells was observed in all strains. Total cell populations (surviving plus non-surviving cells) in all three strains showed essentially equivalent division-delay responses. However, surviving cells of the mutant strains revealed division delays that were much longer than those of the total cell populations. A model is proposed to interpret these results. A basic premise of the model is that, if more time is allowed for repair of potentially lethal damage incurred by the sensitive strains, cellular survival will be greater. Support for this model was obtained by producing artificially long delays in populations consisting of irradiated mutant cells. Increases in survival were observed for the sensitive strains but not for strain NC-4. (auth)

56390 OBSERVED VARIATIONS OF RBE VALUES IN THE STOPPING REGION OF A 95 MeV NEGATIVE PION BEAM. Baarli, J.; Bianchi, M. (European Organization for Nuclear Research, Geneva). Int. J. Radiat. Biol.; 22: No. 2, 183-6(Aug 1972).

The RBE of a 95 MeV stopped negative pion beam (from the CERN 600 MeV Synchro-cyclotron) was studied in relation to the growth reduction in primary roots of Vicia faba during 10 days after irradiation. Irradiations were carried out in aerated water at 4°C at a dose-rate of 3.1 rads/hr on either side of the pion capture peak. The ^{60}Co γ irradiation was carried out in the same way at 15 rads/hr. A greater efficiency was observed at the back of the stopping region compared with the front. RBE also increased with decreasing dose. (UK)

56391 APPLICATION OF NUCLEAR ENERGY FOR INCREASE OF FOOD PRODUCTION IN POLAND. Starzynski, Kazimierz (Agricultural Univ. of Warsaw). Nukleonika; 16: No. 9, 429-35(1971).

In Poland, application of isotopes and ionizing radiation in agricultural researches dates from 1955. In recent years, the studies concern mainly: improving varieties of cultivated plants (wheat, barley, oats, rye, soybean, poppy) and simultaneously some general problems as far as radiobiology and radiogenetics; increasing of the soil fertility — the effects of different factors on utilization of fertilizers, root system, herbicides, and retardants; plant protection — ecology of insects pests, waiting period, sterile-male technique; animal nutrition — mineral compounds and protein metabolism; methods of physiological anemia counteraction of sucklings pigs; and disturbances of thyroid activity in animals, a problem of great importance in mountain regions. (auth)

56392 X-RAY INDUCED MUTATION IN COWPEA (VIGNA CATJANG). Pokle, Y. S. (Coll. of Agriculture, Nagpur, India). Sci. Cult. (Calcutta); 38: No. 1, 34(Jan 1972).

Seeds of three varieties of cowpeas (Vigna catjang) were x-irradiated with 20,000 to 80,000 R doses. After the plants were harvested the seeds were sown and among the progeny a plant with white flowers was observed. When this mutant was crossed with the normal violet-flowered plants, all plants had violet flowers showing that the gene for white color is recessive. (H.L.W.)

56393 NOTE ON THE EFFECTIVENESS OF LEAD SHIELDS FOR IMPROVING THE ROOTING OF IRRADIATED GRAPE CUTTINGS. Sharma, R. L.; Mukherjee, S. K. (Himachal Pradesh Univ., Calcutta). Sci. Cult. (Calcutta); 38: No. 1, 36-8(Jan 1972).

Two types of lead shields, pitted and ring, were prepared for protection of the cambium and root primordia of plant cuttings against gamma and x radiation during exposure for mutation induction. The effectiveness of both types of shields was tested using dormant cuttings of Pusa seedless grapes treated with 3 or 4 kR doses of gamma radiation. The extent of sprouting and survival was recorded at weekly intervals. The number of roots and callusing were increased in the shielded plants; therefore the use of either of the two types of shields for covering the basal portion of the cuttings during irradiation is recommended. (H.L.W.)

56394 COMPARATIVE CYTOLOGICAL EFFECTS OF THE PESTICIDES MENAZON, METROBROMURON AND TETRACHLOROISOPHTHALONITRILE IN HORDEUM AND TRADESCANTIA. Tomkins, D. J.; Grant, W. F. (McGill Univ., Montreal). Can. J. Genet. Cytol.; 14: No. 2, 245-56(Jun 1972).

The biological effects of an s-triazine insecticide: menazon (MEN), a substituted urea herbicide: metobromuron (PAT) and an aromatic hydrocarbon fungicide: tetrachloroiosphthalonitrile (DAC) were compared with those of ethylmethanesulfonate (EMS) and x irradiation. Seeds of barley (Hordeum vulgare L.) were soaked in solutions of the chemicals before determining percentage germination, seedling height, and frequency of chromosomal aberrations. In addition, somatic mutations in inflorescences of Tradescantia clone 02 treated with solutions of the chemicals were counted. X-rays induced a high frequency of chromosome breaks but had no effect on any other character. In contrast, EMS had a pronounced effect on all the characters studied. Only one pesticide, PAT, had significant effects. The herbicide reduced germination percentage, seedling height, and the mitotic index in barley. It is concluded that EMS and x rays have a cytogenetic action in the treated cells, whereas PAT induced a severe physiological effect. (auth)

56395 EFFECT OF PRE-SOWING EXPOSURE OF SEEDS TO GAMMA-RADIATION ON THE DROUGHT RESISTANCE BEHAVIOUR OF BARLEY PLANTS (HORDEUM VULGARE L.). Garg, O. K.; Misra, B. C.; Singh, B. P. (Banaras Hindu Univ., India). Plant Soil; 36: No. 1, 39-45(1972).

A pot-culture experiment was conducted at a glasshouse attached to the Department of Plant Physiology. The plants were subjected to wilting treatments at tillering stage and were maintained so for ten days. Subsequently, observations on survival capacity, growth behavior and physiological changes were made during the wilting period. The data obtained were subjected to statistical analysis. Reduction in soil moisture causes a setback in the physiological status of barley plants and thereby inhibits the crop growth. Presowing exposure of seeds to gamma radiation induced drought tolerance in barley plants. It not only improved the growth behavior but also maintained an active metabolism in plants even under wilting condition. Although the investigation is of preliminary nature, it extends the scope of research towards utilization of gamma radiation in relation to drought tolerance in crops. (auth)

56396 EFFECTS OF ACUTE X-IRRADIATION UPON GROWTH OF PARTHENOCISSUS TRICUSPIDATA AXILLARY BUDS. 1. MORPHOLOGICAL DAMAGE AND RECOVERY. Langenauer, H. D.; Osborne, T. S.; Haskell, D. A. (Smith Coll., Northampton, Mass.). Radiat. Bot.; 12: No. 4, 297-306(Sep 1972).

Parthenocissus tricuspidata axillary buds at varying stages of development were exposed to 600 R (558 rads) of acute soft x-rays. With respect to treatment response, buds could be divided into two populations according to developmental age at the time of treatment. Buds irradiated within 2 days after release from apical inhibition produced slower growing shoots than buds irradiated 4, 6, or 8 days after release. While older-treated buds produced morphologically abnormal shoots more frequently, they were more likely to recover normal development, than abnormal shoots from younger-treated buds. Blind shoots, in which the original apical meristem is functionally aborted, occurred with equal frequency in both populations. Possible mechanisms are discussed. (auth)

56397 MUTATIONS INDUCED IN McINTOSH APPLE BY IONIZING RADIATION. Lapins, K. O. (Canada Agriculture, Summerland, B. C.). Can. J. Plant Sci.; 52: No. 2, 209-14 (Mar 1972).

Irradiating McIntosh scions with gamma rays from a ^{60}Co source induced many mutants with reduced vigor or spurred growth habit, but nearly all of the mutants had unacceptable fruit characteristics. A wide array of fruit mutations occurred, most of which were inferior to the original cultivar. About half of the irradiated material had reduced fertility. Most of the semifertile mutants had 31 to 32% stainable pollen, whereas the untreated controls had 49 to 50% stainable pollen. In the second-test planting, significant differences were found among the final 10 selections in vigor of tree, biennial bearing index, number of seeds per fruit, fruit size, shape, and skin and flesh color. One selection had better fruit shape and skin color than the original cultivar. (auth)

Radiation Effects on Animals (External Source)

Refer also to abstracts 56333, 57909, 57921, and 57922.

Man

Refer also to abstracts 57893, 57897, and 57898.

56398 (ABCC-TR-0-71) BIBLIOGRAPHY OF PUBLISHED PAPERS OF THE ATOMIC BOMB CASUALTY COMMISSION, 1971. (Atomic Bomb Casualty Commission, Hiroshima (Japan). Atomic Bomb Casualty Commission, Nagasaki (Japan)). 1971. 8p. Dep. NTIS.

A bibliography of 71 references to biological and medical studies on atomic bomb survivors is presented. Author and subject indexes are included. (H.L.W.)

56399 (ABCC-TR-41-59 (pp 1-16)) MEDICAL SEQUELAE OF THE ATOMIC BOMB EXPLOSION. LeRoy, George V. (Atomic Bomb Casualty Commission, Hiroshima (Japan). Atomic Bomb Casualty Commission, Nagasaki (Japan)). (In Japanese and English).

Parallel texts are presented in English and Japanese of an article appearing in the Journal of the American Medical Association, 134: 1143-8, 1947. The article was previously abstracted from the original journal in Guide to Published Research, Vol. 2: No. 7 (November 1947) as abstract number 1232. The following topics are included in the discussion: analysis of the types of casualties; casualty-producing agents resulting from explosive nuclear fission in an atomic bomb; classification of injuries and major types of wounds; onset of symptoms of radiation injury; and therapeutic objectives in the management of patients with radiation injuries. (E.R.B.)

56400 (ABCC-TR-41-59 (pp 17-41)) HEMATOLOGY OF ATOMIC BOMB CASUALTIES. LeRoy, George V. (Atomic Bomb Casualty Commission, Hiroshima (Japan). Atomic Bomb Casualty Commission, Nagasaki (Japan)). (In Japanese and English).

Parallel texts are presented in English and Japanese of an article appearing in the Archives of Internal Medicine, 86: 691-710, 1950. The article was previously abstracted from the original journal in NSA vol. 5 as abstract number 935. The hematological sequelae of atomic bomb survivors in Hiroshima and Nagasaki are discussed as functions of distance from ground zero and time. (E.R.B.)

56401 (JPRS-57139) SPACE BIOLOGY AND MEDICINE. Translation of Kosm. Biol. Med.; 6: No. 4, 3-90(1972). 151p. NTIS.

The report contains articles concerning the selection and training of cosmonauts; evaluation and analysis of accumulated data to facilitate the on-going transition from orbital to interplanetary flights; research aimed at guaranteeing safety on long flights and reliability of the human component of the man-spaceship system; space psychology and physiology; environmental problems and control (spacecraft habitability, effects of radiation and weightlessness, etc.) and telemetry. (auth)

56402 (LA-4931) PHYSICAL AND RADIOBIOLOGICAL ASPECTS OF π^- MESONS IN RADIOTHERAPY. Raju, Mudundi R. (Los Alamos Scientific Lab., N. Mex.). Aug 1972. Contract W-7405-eng-36. 16p. Dep. NTIS.

The object of radiation therapy is to sterilize all cancer cells in a tumor-suspected volume yet make it possible for the normal vital structures within that volume to survive and repopulate it. In addition, radiation damage to exposed normal tissues must be kept to a minimum. This paper discusses the application of π^- mesons to these problems. The results of physical and radiobiological measurements of π^- mesons with reference to therapy, current plans for using π^- mesons in therapy, and problems associated with evaluating their potential are discussed. (auth)

56403 (NRPB-R-2) STUDY OF CHROMOSOME ABERRATION YIELD IN HUMAN LYMPHOCYTES AS AN INDICATOR OF RADIATION DOSE. I. TECHNIQUES. Purrott, R. J.; Lloyd, D. C. (National Radiological Protection Board, Harwell (England)). Aug 1972. 11p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

Estimates of exposure to ionizing radiation can be obtained by determining the yield of chromosome aberrations in cultured human lymphocytes. Chromosomes can only be conveniently examined during cell division. The lymphocytes, which do not normally divide while circulating, are stimulated to divide during a 48-hour culture period. Two types of culture technique are described, one of which employs a lymphocyte-enriched inoculum and the other which uses whole blood. After culture the cells are harvested, dispensed onto slides and prepared for microscopic examination. An account is also given of the analysis of various types of radiation-induced chromosome aberrations and of the construction of calibration curves for certain types and rates of radiation which are used to interpret the aberration yields in terms of dose. (auth)

56404 (SZS-130 (pp 1-12)) APPLICATION OF CHROMOSOME ANALYSIS TO BIOLOGICAL DOSIMETRY. Grigoroff, L.; Gensicke, F. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). May 1972. (In German). Dep. NTIS (U. S. Sales Only).

A literature survey is given on chromosome analysis after external irradiation with regard to biological dosimetry. The possibilities and limitations of biological dosimetry on the basis of the assessment of chromosome aberrations in lymphocytes of the peripheral blood are outlined, and the radiation-induced chromosomal changes in other tissues, especially in bone marrow, are discussed. With the latter better results may be expected in the case of inhomogeneous irradiation of the organism. (auth)

56405 (SZS-130 (pp 13-24)) CHROMOSOME ANALYSIS AFTER RADIOTHERAPY OF TUMOUR PATIENTS. Anger, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). May 1972. (In German). Dep. NTIS (U. S. Sales Only).

Results of chromosome analyses of cultured peripheral lymphocytes carried out before and after radiotherapy of tumor patients are presented. There was one group of patients with various types of tumors and irradiation treatments and another group with bronchial carcinoma or carcinoma of the esophagus which were treated with standardized ^{60}Co γ irradiation. The results are compiled in tables and compared. (auth)

56406 INVESTIGATION OF THE DISTRIBUTION OF X-RAY INDUCED STRUCTURAL ABERRATIONS OF HUMAN METAPHASE CHROMOSOMES AS A FUNCTION OF INTRANUCLEAR POSITION. Fatora, S. Robert. Pittsburgh; Univ. of Pittsburgh (1971). 181p. University Microfilms Order No. 72-18,295.

Thesis.

In accordance with the physical model of x-ray and chromatin interaction, previous investigations have dealt with spatial proximity of chromatin but not with the spatial position of chromosomes. An investigation of the effect of spatial position upon the formation of aberrations requires information regarding the level of order that exists in normal metaphase cells. Given three male individuals who were accidentally exposed to excessive radiation with respective average whole-body doses of 100, 300, and 600 rads, it was possible to randomly select 21 normal and 21 abnormal cells per patient. The absence of structurally aberrant chromosomes (rings, dicentrics, chromatid breaks, and acentric fragments) was the criterion for normal cells. To study the spatial distribution of normal and abnormal chromosomes, each metaphase figure was geometrically depicted by the delta and the most dispersed chord methods. The delta method represented each chromosome as a set of points corresponding to the centromere and the midpoint of each chromatid. The spatial position of a chromosome was determined by the most dispersed chord method which utilized the greatest distance between any two peripheral chromosomes to define total cell area and its three subdivisions: peripheral (P), intermediate (I), and central (C) areas (P = C for all cells). Thus, it was possible to utilize a probability model based on the spread of the peripheral chromosomes relative to the remaining chromosomes of a particular cell for testing the uniform distribution of chromosomes according to length and centromere position. For the normal cell sample, the normal metaphase chromosomes follow a uniform intracellular distribution with regard to length and centromere position. There was a non-uniform intercellular distribution of certain individual chromosomes. These chromosomes and their corresponding preferential cell areas are: peripheral—chromosome 1; intermediate—chromosomes 19 and 20; and central—chromosomes 7, 9, 12, 13, and 22. The involvement of chromosomes in aberration production was uniform with regard to relative metaphase length; notable exceptions being the under response of the G group and Y chromosomes. The intercellular distribution of abnormal chromosomes was non-uniform with an excessive number of hits (80) in the peripheral area and a corresponding deficiency (52) in the central area. Interacting with this "spatial position effect" is the nuclear membrane and its plausible role of a dynamic structure. Both elements are discussed in light of Comings' model for an ordered arrangement of chromatin and Wolff's exchange site hypothesis. (Diss. Abstr.)

56407 COMPARATIVE STUDY OF THE TENSILE STRENGTH OF AUTOGENOUS SYSTEMIC VEINS AND PRESERVED VENOUS HOMOGRAFTS. Parodi, Eduardo N.; Kaiser, Gerard A.; Wolff, Marianne; Kovalik, A. T. W.; Malm, James R. (Columbia Univ., New York). J. Surg. Res.; 12: No. 2, 99-104(Feb 1972).

There is a minimum decrease of tensile strength in saphenous veins after irradiation (5%), when compared to fresh controls. This difference is larger in cephalic and brachial veins (45 to 55%), when compared to the fresh saphenous vein controls. There is no demonstrable morphological alteration in the saphenous vein walls after irradiation and freezing. We suggest the use of saphenous vein homografts, sterilized by irradiation and preserved by freezing, in those cases in which it is not feasible to use saphenous vein autografts. (auth)

56408 GENERAL SAFETY CONSIDERATIONS. Farmer, F. R. (United Kingdom Atomic Energy Authority, Risley, Eng.). Nucl. Safety; 13: No. 5, 362-4(1972).

The annual mortality risk arising from a reactor suffering accidents at the frequency defined by the limit line is assessed. The problem of mathematical definition of the limit lines is discussed and the total individual mortality risk calculated at 300 m to be 2.3×10^{-7} per year. (M.C.G.)

56409 GENERAL SAFETY CONSIDERATIONS. Erdmann, R. C. (Univ. of California, Los Angeles). Nucl. Safety; 13: No. 5, 365(1972).

Hazards to nearest individual at reactor site boundary (300 m) in case of an accident are considered. Population density is discussed and the limit line concept use in safeguards mentioned. (M.C.G.)

56410 RADIATION INJURIES. Kumatori, Toshiyuki (National Inst. of Radiological Sciences, Chiba, Japan). Shindan To Chiryo; 59: No. 8, 258-62(Aug 1971). (In Japanese).

Exposure to radiation dealt with as an acute dangerous disease is attributed to accidents and includes extracorporeal exposure to a large dose in a short time, intracorporeal exposure, and exposure by skin contamination. The procedures to be taken at the time of an accident were detailed. Extracorporeal exposure to a large dose of x rays, gamma rays, and neutrons in a short period poses problems. The diagnosis, symptoms, and necessary medical tests of this disease were mentioned, and time-course changes of the lymphocytes, neutrophils, thrombocytes, erythrocytes, and marrow due to exposure to radiation were illustrated. The procedures for extracorporeal exposure, which is symptomatic in most cases, were described. Precautions in removing skin contamination with the presence of skin necrosis and that without it were stated in view of the future prevention of necroses. Methods for dealing with intracorporeal exposure to radioiodine and ^{3}H were reported on, and a method of the administration of chelating agents was described. (Japan)

56411 RADIATION MENOPAUSE. Mills, W. G. (Birmingham and Midland Hospital for Women, Eng.). Brit. Med. J.; 3, No. 5826, 586(2 Sep 1972).

Criticism is made of a previous discussion of the effects of radiation produced menopause [Br. Med. J. p. 365 (13 May 1972)]. The induction of a menopause by insertion of a 50 mg radium tube is briefly discussed in relation to experiences at the Women's Hospital, Birmingham, between 1935 and 1970. It is suggested that intrauterine radium might in some cases be more beneficial than external radiation. There were indications that the intrauterine treatment inhibited the development of a typical endometrial hyperplasia into subsequent malignancy. (UK)

56412 IS RADIATION EXPOSURE AN ACCEPTABLE RISK? Schwibach, J. (Bundesgesundheitsamt, Neuherberg, Ger.). Umwelt; No. 5, 19-24(1971). (In German).

Nuclear tests and the industrial application of nuclear energy have entailed the risk of possible radiation hazards from nuclear technology to everybody, which considering the rapid progress and development, might develop into a real danger if no precautions are taken. In order to avoid injuries in men, animals, and plants, there must be further research on the hazards of ionizing radiation. Beyond that the technical safety of nuclear power plants must be improved continuously, and radiation protection measures have to be developed steadily. (INIS)

56413 ANALYSIS OF ABSORBED RADIATION DOSES IN A NON HOMOGENEOUS ENVIRONMENT. Dubinin, I.; Prudil, L.; Pohlova, L. Cesk. Radiol.; 26: No. 2, 63-6(Mar 1972). (In Czech).

Selective absorption of radiation in tissues of various linear absorption coefficients for a given radiation, and its influence on localization of absorbed dose of radiation, documented on the example of isodose plan for irradiation of chest is reported. (auth)

56414 PROTECTION FROM IONIZING RADIATIONS IN THE FIELD OF RAILWAY TRANSPORTATION. Melino, C.; Chiriatti, G. N. (Univ., Naples). Folia Med. (Naples); 54: 77-92(1971). (In Italian).

The problem of the protection against ionizing radiations in the specific field of transport is discussed. This is particularly important because of the increasing number of cases containing radioactive substances that are sent everywhere in the country and because of the potential possibility of accidents that might endanger the safety of numerous groups of the population. Therefore, the problem regards particularly the protection of the personnel employed in transports (especially railway transport): this requires a continuous physical control of the working place and a medical control of the worker himself. We find several statistics about railway transport that show how this category of transport is increasing and also compel the technical organs deputed to the protection to a greater engagement. (auth)

56415 GENETIC EFFECTS OF LOW LEVEL IRRADIATION. Grahn, Douglas (Argonne National Lab., Ill.). Bioscience; 22: No. 9, 535-40(Sep 1972).

This has been a brief overview of some of the problems concerning the estimation of the potential genetic hazards to man of low levels of ionizing radiation. Our knowledge of certain radiation induced mutation rates is good for mice and Drosophila, but is not for man, so that all estimates of genetic injury must be theorized and extrapolated from the laboratory data. Several methods of extrapolation have been discussed, and the induced genetic damage for a 5 R/generation dose can be expected to induce as little as a 3% increase in the spontaneous frequency of genetic defects per year at the new equilibrium. This would be a 6.18% frequency of defects among the live born. However, it is conservatively concluded that a widely accepted rule-of-thumb assumption be continued as the basis of prediction—if 10% of the spontaneous load is attributable to background radiation then doubling that dose would increase the genetic burden by 10% or to about 6.6% genetic defects per year at equilibrium. The MPD is approximately a background doubling dose. The use of hospital and vital statistical records for epidemiological-genetic studies is generally unsuitable for the detection of small changes in mutation pressure. The endpoints of fetal death, sex ratio, malformation rate, neonatal and infant mortality, and childhood and adult mortality and morbidity are either intrinsically imprecise, or have too small a genetic component, or both. Selected endpoints in this array can be used, if they are either because of single gene mutations or are known to have a high genotypic-phenotypic correlation. Present day efforts to demonstrate genetic effects of radiation at fractions of natural background levels must therefore have little or no genetic or epidemiologic substance. In spite of the problems associated with vital records, a determined effort should be made to establish population cohorts that can be longitudinally studied. Only in this way will the real value of this least expensive data collection be ascertained. Classical genetic theory suggests that a directly proportional relation should exist between mutation rate and population expression. Yet, as recently discussed by Franklin and Lewontin (Franklin and Lenontin 1970), there is a breach between theory and practice. With few exceptions, the detection and measurement of single-gene substitutions are virtually impossible in a population study. If, as postulated by Lewontin, population genetic theory should be completely revised to accommodate a "theory of the correlated genome," and if it can be demonstrated that one should be dealing with whole chromosomes or other large genomic subunits, then these linear and proportional predictions may become only an academic exercise. (auth)

56416 INJURIES OF THE LENS. Abboud, Ibrahim. Bull. Ophthalmol. Soc. Egypt; 63: 15-23(1970).

A review is presented of various types of cataracts; causes and complications of cataracts are described. Other types of lens injuries such as dislocation, glaucoma, and injuries due to foreign bodies are discussed. A review is given of radioinduced keratoconjunctivitis following exposure to ultraviolet, x, and gamma rays and cataracts following exposure to infrared, x, gamma, and neutron radiation and high voltage beta particles. Effects of age on radioinduced lens injuries are described and the relation of pathogenicity to damaged lens epithelium is discussed. Cataracts resulting from the therapeutic use of ultrasonic waves are discussed as well as cataracts induced by chemical agents such as naphthalene, para-dichloro-benzene, dinitrophenol, and dinitrocresol. Various procedures for the management of injuried lenses are described. (H.L.W.)

56417 IRRADIATION-INDUCED THYROID NEOPLASMS. CASE REPORTS AND REVIEW. Frankel, Kenneth A.; Thomford, Neil R.; Holaday, William J. (Ohio State Univ., Columbus). Ohio State Med. J.; 68: No. 4, 347-9(Apr 1972).

External irradiation of the neck appears capable of inducing the development of thyroid neoplasia. Radiation-induced neoplasms of the thyroid include both adenomas and carcinomas. Neoplasia is throught to be the result of a direct effect of irradiation on thyroid epithelium. An indirect effect of apparent importance is increased production of TSH secondary to the hypothyroidism caused by the irradiation. Patients with abnormalities of the thyroid who have a history of irradiation to the head or neck should be advised to undergo an operation. (auth)

56418 TREATMENT OF RADIATION LESIONS OF THE RECTUM BY INJECTION OF MEDICAL AGENTS IN THE PRESACRAL REGION. Lubenets, E. N. (Inst. of Public Health, Leningrad). Vop. Onkol.; 18: No. 6, 32-5(1972). (In Russian).

A description of the technique of presacral injection of hydrocortisone, vitamin B_{12}, penicillin, and streptomycin in 0.25% novocain solution, employed for therapy of radiation lesions of the rectum in patients, previously subjected to radiation therapy for cancer of the female genitalia is presented. Twenty five patients with catarrhal erosion-desquamous and ulcerous-infiltrative lesions of the rectum were treated. The efficacy of the mentioned technique is being emphasized. A complete cure was gained in 21 patients, considerable improvement in 3, and some improvement in 1. (auth)

56419 MALE GONADAL SHIELDING DURING COBALT TELETHERAPY. Glenn, Dwight W.; Johnson, Ralph E. (National Cancer Inst., Bethesda, Md.). Radiology; 104: No. 1, 214(Jul 1972).

A male gonadal shield for use in cobalt teletherapy of the pelvic area is described. Reduction of the dose to the gonads by lead blocks placed on a shadow tray is enhanced another 50% by the use of a simple scatter shield. (auth)

56420 RADIATION EXPOSURE TO STAFF CARDIOLOGIST VS. SENIOR RESIDENT CARDIOLOGIST AND PATIENTS DURING CARDIAC CATHETERIZATION. Malsky, Stanley J. (Manhattan Coll., Bronx, N. Y.); Haft, Jacob; Hayt, David.; (and others). Radiat. Data Rep.; 13: No. 7, 387-91(Jul 1972).

A study was conducted to compare the x radiation exposure received by a senior resident cardiologist to that of the staff cardiologist when performing a full cardiac catheterization procedure. In addition, patient exposure values were obtained. The staff cardiologist was found to receive approximately 50 to 60 mR/procedure in the chest region and the senior resident received approximately 61 to 73 mR. The exposure to patients, as calculated from tabletop measurements, varied from 24 to 73 R. (auth)

56421 DUTIES OF CNEN INSPECTORS. Nocera, F. (CNEN, Rome); Carbone, F. Bull. Droit Nucl.; No. 9, 63-72 (Apr 1972). (In French).

The decree number 185 of the President of the Republic lays down rules concerning the establishment of an inspectorate for the CNEN. The field of action open to the administrators and that open to the CNEN do not completely coincide: the functions of the inspectorate have a technical nature, which is both general and specialized at the same time. The work accomplished by this inspectorate in common with other administrative bodies and in accordance with the 185 decree covers only part of the functions of the inspectorate; a tremendous freedom of action is reserved for the members of the inspectorate. These inspectors have general duties concerning surveying of nuclear activities as well as duties that complete or replace (exceptionally) those of other organizations. The CNEN inspectorate possesses special legal privileges. (France)

56422 IONIZING RADIATIONS AND PERSONNEL RADIOPROTECTION. Jezequel, E. J. L. (Direction des Recherches et Moyens d'Essais, Paris). Rev. Def. Nat.; 27: 1878-90(Dec 1971). (In French).

Personnel radiation hazards are discussed, thermomechanical aspects of nuclear explosions being excluded. Internal contamination resulting from contamination of water or food chains is mentioned. The need for more fundamental research on the effects of ionizing radiations and the systematic study of radioprotecting chemical substances is stressed. Work undertaken by the Direction des Recherches et Moyens d'Essais and other research centers in this field is presented. (France)

56423 EXPERIENCE IN SURGICAL TREATMENT OF LATE RADIATION INJURIES. Bogatskii, V. A. Stomatologiya; 51: No. 1, 33-4(1972). (In Russian).

The results of surgical treatment are reported for 56 patients with radiation injuries of the soft tissues and bones of the face (underdevelopment of the facial skeleton or soft tissue atrophy were found in 4 patients, scars and deformity of individual anatomical areas of the face in 17, radiation ulcers in 16, and radiation osteomyelitis of the jaws in 19 patients) are presented. The author considers that the borders of nonviable tissues are the zone of pigmentation, teleangioectasies, and atrophy. Extensive operations were performed with removal of the affected bone, and in case of affection of soft tissues as well, a block resection of the involved area with subsequent plastic surgery. Early surgical intervention is recommended. (auth)

56424 EFFECT OF IONIZING RADIATION ON THE GENITAL SYSTEM IN MAN. Vaskov, L. (Research Inst. of Labor Protection and Occupational Diseases, Sofia). Akush. Ginekol; 8: 135-9(1969). (In Russian).

The existence of a threshold dose of external ionizing radiation on human gonads is discussed. The literary data on the effects of acute radiation and the continuous effect of small doses of ionizing radiations on the genital system are reviewed. The possibilities for early clinical diagnosis of the radiation injuries in the gonads are evaluated and personal observations on persons with continuous length of service in an ionizing environment are discussed. (auth)

56425 SHIELDING OF FAST NEUTRON CANCER THERAPY SOURCES. Parnell, C. J.; Kelsey, C. A. (Univ. of Wisconsin, Madison). Health Phys.; 23: No. 4, 576-8(Oct 1972).

Estimates were made of the incidence of radiation induced carcinoma and leukemia resulting from whole-body irradiation received during a course of fast neutron therapy. The value of the RBE to be assigned to the whole body dose was decided with regard to various literature sources. Factors taken into account were the relative proportions of neutrons and γ rays in the whole body dose, and the energy distribution of the neutrons, depending on the composition of the shielding room scatter, proximity of the site of interest to the treatment volume, etc. Treatment in 12 fractions was assumed, each consisting of two treatment fields, each field being treated to a total dose of 1000 rad. An incidence for all malignancies was assumed of 3 cases/1000,000 persons/yr/rem. The estimated incidence of radiation malignancies was between 0.09 and 1.44 % over a range of RBE from 1 to 16. (UK)

56426 EVOLUTION OF BIOLOGIC CHANGES NOTICED IN THREE CASES OF ACCIDENTAL MILD GAMMA IRRADIATION. Popescu, Horis L.; Pilat, L.; Hilt, M.; Lancranjan, Ioana (Inst. of Hygiene and Public Health, Bucharest). J. Occup. Med.; 14: No. 4, 317-20(Apr 1972).

Three men, members of an industrial γ radiography crew, were accidentally exposed to irradiation from a source of ^{192}Ir. The distances from the source were different for each of the three men. Radiation doses were calculated separately for three different areas of the body: head, 3 to 6 rads; sternum, 2.5 to 12 rads; and gonads, 3 to 26 rads. On the second day after the accident and from one to eleven months later, the men were subjected to hematological, biochemical, and endocrinological examinations. Results are reported for blood coagulation, blood cell counts, chromosome aberrations in the bone marrow and peripheral blood, content of urinary amino acids, ketosteroids, and gonadotropins, and sperm volume and count. Although the doses were small, some changes were observed in the chromosomes and in the amino acid content of the urine. The two subjects that received the highest doses showed a transient occurrence of immature cells in the blood and binucleated lymphocytes were observed in all three subjects. (H.L.W.)

56427 DATA ON THE TREATMENT OF LOCAL RADIATION INJURY USING ETHONIUM AND METACIL. Kokhanovskaya, R. S.; Mishenda, N. P.; Pis'ko, G. T. Vrach. Delo; 106-8(1971). (In Russian).

Results are presented of methonium and metacil treatment of radiation lesions in patients following radiation treatment for malignant tumors. Among the involved organs were: skin, rectum, urinary bladder, and vagina. Ninety-nine patients received metacil and 66 ethonium. With ethonium, healing of radiation lesions was quicker than with metacil. (auth)

56428 RADIATION-INDUCED TUMORS IN THE EAR-NOSE-THROAT REGION. Nitze, H. R. Arch. Klin. Exp. Ohren-, Nasen- Kehlkopfheilk; 199: No. 2, 634-7(1971). (In German).

The number of radiation-induced tumors was low, compared to the number of radiotherapeutic treatments. The reasons for this are briefly reviewed. Eight cases, observed during the last few years, are presented. (GF)

Vertebrates

Refer also to abstracts 56356, 56504, and 56554.

56429 (AECL—4213, pp 25-8) POPULATION RESEARCH. Jun 1972.

Research on hereditary changes in vertebrates included studies on low-dose effects in fish embryos from irradiated sperm and chromosome cytology of irradiated fish. Methods for deriving human data on diseases likely to be increased by irradiation were studied with regard to organization of birth and marriage records and ascertainment of congenital malformations through hospital records. A proposal for studies on human cancer following multiple fluoroscopic diagnostic radiographic examinations is described. (H.L.W.)

56430 (BRH/DBE-72-2) CSU-PHS COLLABORATIVE RADIOLOGICAL HEALTH LABORATORY ANNUAL REPORT 1971. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology. Bureau of Radiological Health, Rockville, Md. (USA). Div. of Biological Effects). Jan 1972. 142p. NTIS.

Studies on radiosensitivity of the prenatal, neonatal, and adolescent beagle dogs included effects of age on the acute lethal response to ^{60}Co gamma radiation: an analysis of sex differences; radio-induced life-shortening renal disease; electroencephalographic analysis of evoked responses in irradiated dogs; determination of ovulation time; effect of irradiation on glycogen-synthetic enzymes in fetal dogs; comparison of statistics for litter sizes, birth weights, and total litter weights as function of dose; and method for analysis of growth and development data. Studies of the prepubertal and adult animal included mortality in preselected aging canine populations; effects of age on aortic ejection time and the mechanical properties of arteries; evaluation of a pulsed ultrasonic Doppler technique for assessment of cardiovascular function; persistent proteinuria in adult beagles; evaluation of the ^{125}I-T$_3$ thyroid function test; cutaneous squamous cell carcinoma; and effects of age on starvation induction of hepatic serine dehydrase in rats. (H.L.W.)

56431 (COO-1210-78) EFFECTS OF IRRADIATION ON ERYTHROCYTE CHIMERISM AND IMMUNOLOGIC TOLERANCE IN CATTLE TWINS. Annual Technical Progress Report Covering the 10th Year Period from November 15, 1971–September 14, 1972. Stone, William H. (Wisconsin Univ., Madison. Dept. of Genetics). 15 Aug 1972. Contract AT(11-1)-1210. 12p. Dep. NTIS.

Progress is reported on the following projects: effects of gamma radiation on erythrocyte chimerism and immunologic tolerance in cattle twins; physiological studies on kidney transplants in cattle twins; production of chimerism in birds by parabiosis of embryonating eggs and somating cell mating; effects of anemia and chemicals on erythrocyte chimerism in cattle twins; studies on serum proteins in cattle; studies on blood groups of rhesus monkeys; histocompatibility studies on cattle lymphocytes; and histocompatibility testing of human lymphocytes with cattle isoimmune and heteroimmune sera. A list of 17 publications on this research is included. (H.L.W.)

56432 (JPRS-56675) SPACE BIOLOGY AND MEDICINE, VOL. 6, NO. 3, 1972. Translation of Kosm. Biol. Med.; 6: No. 3, 3-90(1972). 143p. NTIS.

This cover-to-cover translation of the Soviet journal, Space Biology and Medicine, contains articles concerning the selection and training of cosmonauts; evaluation and analysis of accumulated data to facilitate the on-going transition from orbital to interplanetary flights; research aimed at guaranteeing safety on long flights and reliability of the human component of the man-spaceship system; space psychology and physiology; environmental problems and control (spacecraft habitability, effects of radiation and weightlessness, etc.) and telemetry. Data are included from studies on the effects of chronic exposure to γ radiation at doses of 0.06, 0.2, and 0.4 rad/day during a three year period on the functional activity of leukocytes in dogs and the effects of a total dose of chronic γ radiation of 188.5 rad/yr on the functional state of the vestibular apparatus of dogs following a three year exposure. (C.H.)

56433 EFFECTS OF THERMAL STRESS AND GAMMA RADIATION ON MORTALITY AND HEMATOPOIESIS IN MICE. Ross, William MacGregor. Toronto; Univ. of Toronto (1971). National Library of Canada, Ottawa.

Thesis.

Female mice (CBL albino) weighing 18–22 grams were exposed to two simulated components of a nuclear detonation, specifically the thermal component and the gamma component of the residual ionizing radiation. These were applied singly or in combination. The thermal stress (B) was delivered by a 500 watt I.R. bulb to the shaved back of the deeply anaesthetised animal, the exposed area representing about 10% of the body surface. The gamma component was delivered over a 96 hour period by a 250 Ci ^{60}Co source to the whole body either at a constant dose rate (CR) or at a fallout dose rate (F). The fallout rate was varied as a power function of time ... $R_t = R_{10}t^{-1.2}$. For combined stress experiments the thermal stress preceded the gamma radiation stress by 3.5 hours and was found to definitely modify mortality. When a 30 second thermal exposure (B.30) preceded gamma radiation radioprotection was evident. The LD50 estimate was increased by about 16% over that for the radiation alone (e.g., 852 R to 1006 R). This definite protective effect was also attained when a 45 second exposure (B.45) was used. When a 15 second thermal exposure (B.15) preceded constant rate radiation the LD50 was decreased by 16%, but when it preceded fallout no significant change was noted. This latter effect would appear to be a result of differences in delivery of the stress (dose rate). It was found that mice succumbed more readily under a constant rate regime than a fallout regime. Death distribution analysis revealed the protective effect of a 30 second thermal exposure upon irradiated mice to be manifested during the bone marrow syndrome. It was therefore proposed that the protective effect was exerted on the hematopoietic system and that an endogenous spleen colony assay might confirm this. Endogenous spleen colony counts were significantly higher in those animals subjected to 30 or 45 second thermal stress before constant rate irradiation than in those given a 15 second thermal stress before, or the irradiation alone. The D_0 values for the various burn treatment groups were the same (about 130 R) indicating no change in hematopoietic sensitivity was caused by varying the severity of burn. Perhaps more stem cells were present at the time of irradiation or their efficiency at repopulation of the spleen was enhanced by the more severe burn. The dry weights of many spleens from each treatment group were recorded and found to reflect the mortality findings; a 30 second thermal stress protected mice from constant rate gamma radiation and a 15 second thermal stress enhanced radiation mortality. Hypoxia as a possible mechanism was discussed as well as the role of bacterial endotoxins in radioprotection. The enhanced recovery of the hematopoietic system was apparently responsible for the reduction in mortality of severely burned mice during the bone marrow syndrome. (Diss. Abstr.)

56434 STUDIES ON THE BONE MARROW COLONY STIMULATING FACTOR (CSF): RELATION OF TISSUE CSF TO SERUM CSF. Sheridan, J. W.; Metcalf, D. (Royal Melbourne Hospital). J. Cell. Physiol.; 80: No. 1, 129-39(Aug 1972).

Fluctuations in the colony stimulating factor (CSF) content of submaxillary salivary gland, lung, kidney, and spleen were studied in male C_{57}BL mice that were subjected to a variety of stimuli (endotoxin, x irradiation, or polyadenylic-polyuridylic acid complex) that caused elevations of the serum CSF. The temporal relationships and magnitudes of the rises in CSF were complex and differed from tissue to tissue according to the stimulus used. In the tissues examined, not only was the measurable CSF content in each case found to equal or exceed the prestimulatory levels, but in some cases distinctly different forms of CSF were observed as shown by differences in the zone sedimentation, electrophoretic, and calcium phosphate binding characteristics of the material. The patterns of response to the stimuli investigated suggested that tissue injury either directly, or indirectly via the release of various cellular constituents, might mediate the release of CSF by various widely disseminated and/or differing cell types. (auth)

56435 EFFECT OF AZATHIOPRINE ON WHOLE-BODY IRRADIATED MICE AFTER THEIR TREATMENT WITH XENOGENEIC BONE MARROW CELLS. Petyrek, P.; Mraz, J. (Vojensky Lekarsky Vyzkumny a Doskolovaci Ustav, Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hrdci Kralove; 54: 69-75(1971). (In Czech).

Mice were whole-body irradiated with 800 R by gamma rays (^{60}Co). Xenogeneic bone marrow cells were injected in the tail vein about 24 hrs after irradiation. Azathioprine (Imuran) was given per os in the dose of 30 mg/kg daily in the periods from the 1st to the 4th, and from the 7th to 10th day after irradiation. The alkaline phosphatase activity in leukocytes (APL) as the marker of donor cells was tested. (auth)

56436 BONE MARROW MESODERMAL INDUCING FACTOR AFTER IRRADIATION. Roussev, G. K.; Gabrovska, S. L.; Radev, Sk. G. (Univ., Sofia). Experientia; 29: No. 7, 842-3(15 Jul 1972).

In order to study the effects of radiation on the mesodermal-inducing factor isolated from bone marrow of guinea pigs, the animals were exposed to 450 R of x rays and killed 3 hrs later. The marrow was removed from the femurs, tibiae, and humeri and the mesodermal-inducing factor was purified. The ectoderm of the late blastula stage was treated with the factor from irradiated and unirradiated guinea pigs and it was found that the inducing activity of the factor from the irradiated guinea pigs was weaker than that from unirradiated guinea pigs. Some fractions from irradiated guinea pigs caused disintegration of the explants. (H.L.W.)

56437 SURVIVAL OF TYPE A AND B SPERMATOGONIA IN THE MOUSE TESTIS AFTER EXPOSURE TO HIGH DOSE-RATES OF ELECTRONS. Bianchi, Marilena; Ebert, M.; Keene, J. P.; Quintiliani, M. (European Organization for Nuclear Research, Geneva). Int. J. Radiat. Biol.; 22: No. 2, 191-5(Aug 1972).

The effects of low and high dose rates of radiation on mouse spermatogonia were compared, using x-rays and electron irradiation from an 8 to 16 MeV electron accelerator, over a dose range of 0 to 500 rads. Observations of the survival of type B spermatogonia were made with x radiation at 0.7 rad/sec. and electron irradiation at 2×10^7 rads/sec, and 2×10^8 rads/sec.

Testis weight loss experiments used as an indicator of killing of type A spermatogonia were made using x-ray dose rates of 2.5 rads/sec and electron irradiation at 8×10^7 rads/sec. and 8×10^8 sec. The results showed no evidence of difference in effect. (UK)

56438 CHEMICAL PROTECTION AND COMBINED TREATMENT OF ACUTE RADIATION SICKNESS DURING X IRRADIATION OF MICE WITH SUBLETHAL DOSES. Airapetyan, F. O.; Avetyan, N. G.; Alaverdyan, M. I. Biol. Zh. Arm.; 24: No. 7, 75-80(Jul 1971). (In Russian).

A number of chemical compounds were tested for radiation protection activity in white mice that were exposed to whole-body x radiation of 500 R. For example, in testing L-cysteine, each mouse received 0.5 ml intraperitoneally 10 min before irradiation, and daily subcutaneous injections of chondroitinsulfuric acid for 20 days. Other groups received, besides L-cysteine and chondroitinsulfuric acid, 2 g sigmamycin, 10,000 units colimycin, and 4 ml of 5% vitamin B_6, daily for 20 days. Controls were only irradiated. Combined use of these biochemicals resulted in a positive prophylactic effect on the irradiated animals. (K.S.W.)

56439 EFFECT OF A CEPHALIC IRRADIATION (1000 RADS) ON THE CORTICAL BIOELECTRIC ACTIVITY. Laget, P.; Kuentz-Desroches, A. M.; Court, L. (Univ., Paris). Compt. Rend. Soc. Biol.; 165: No. 9, 1840-6(16 May 1972). (In French).

A large single radiation dose (1000 rads) led to significant modifications in the cortical bioelectric activity of young rabbits. These modifications are not permanent and a relatively rapid recovery is observed; this is linked with the fact that during the first post-natal week, a capacity to reorganize damaged structures as well as a certain multiplication capacity exists for some of the young cellular elements, which have not been destroyed by the irradiation. (France)

56440 NUCLEIC ACIDS, FREE AMINO ACIDS, AND NON-COLLAGEN PROTEIN CONCENTRATIONS IN THE HEART OF NON-PROTECTED AND CYSTAMINE-PROTECTED RATS AFTER 700 R WHOLE-BODY GAMMA IRRADIATION. Kuna, P.; Pazderka, J.; Macek, V. (Karlov Univ., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 54: 57-68 (1971). (In Czech).

DNA concentration increased in rate myocardium on the 4th day after whole-body gamma irradiation with 700 R (32.2 to 35.7 R/min). This enhancement became significant on the 10th day. The increase of DNA was even non-significantly higher in cystamine (50 mg/kg i.p., 5-10 min before irrad.)-protected rats after both 4 and 10 day intervals in comparison with non-protected groups. Cystamine protected the RNA rise on the 4th day following irradiation and contrary it elevated significantly the RNA concentration in heart on the 10th day in comparison with non-protected rats. No significant changes in the pool of free amino acids were detected in myocardium of both protected or non-protected rats 4 and 10 days following 700 R of irradiation. In further experiments, a significant increase of heart non-collagen protein (NCP) concentration was observed in both compared groups on the 3rd day after 700 R of gamma irradiation. The elevation of NCP content was in unprotected rats insignificant on the 7th day and its significant fall was found on the 9th day. The increased content of NCP remained in cystamine protected rats until the 9th day following irradiation. (auth)

56441 COMPARISON OF THE PROTECTIVE EFFECTS OF CYSTAMINE, AET, AND 5-METHOXYTRYPTAMINE ADMINISTERED ALONG OR IN A MIXTURE PRIOR TO GAMMA-IRRADIATION OF MICE. Dostal, M.; Mencl, J.; Petyrek, P. (Vojensky Lekarsky Vyzkummy a Doskolovaci Ustav, Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 54: 17-55(1971). (In Czech).

In whole-body γ irradiated mice, the protective effects of the oral administration of mexamine (5-methoxytryptamine) in a mixture with cystamine or AET are compared. On the level of endogenous spleen colony-forming units, AET seems to be more effective than cystamine compared in the same dose of their bases. The effectiveness of AET can be increased in a mixture with mexamine. Mexamine per os equals to the effectiveness of AET only in the lethal exposure level. Quantitative relations of AET or cystamine combined with mexamine are analyzed by the isobole method. In mice protected prior to the irradiation with 1000 R, a synergism of both drugs in binary combinations is described. Both drugs injected simultaneously intraperitoneally in the proportion 3 : 1 are more effective than in the proportion 1 : 3 (AET or cystamine to mexamine). The 1 : 3 combination of AET and mexamine seems to be slightly more effective than the analogous mixture of cystamine and mexamine. The results are discussed from the point of view of literature references related to the problems of aminothiols or their disulfides and indolylalkylamines administered prior to gamma irradiation of mice. (auth)

56442 RADIOSENSITIVITY OF MAMMALIAN CELLS. VII. AGGREGATION AND PSEUDO-GLOMERULE FORMATION OF DISSOCIATED KIDNEY CELLS FROM IRRADIATED NEW BORN MICE. Kobayashi, J. (Tokushima Univ., Japan). J. Radiat. Res.; 13: No. 3, 117-26(Sep 1972).

The effects of irradiation on aggregate and pseudo-glomerule forming activity were studied quantitatively using dissociated kidney cells from new born mice. The dissociated cells formed macroscopic aggregates and microscopic inner structures, pseudo-glomerules, on the bottom of plastic dishes. The inhibitory effects of irradiation on aggregation and pseudo-glomerule formation were detectable with a dose of as low as 10 R. However these abilities to form aggregates or pseudo-glomerules were not completely lost even after irradiation with a dose of 1000 R. (auth)

56443 MODIFICATION OF RADIATION LETHALITY IN MICE BY ANTITHROMBOCYTE SERUM INJECTION. Kojima, E.; Nakamura, W. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 13: No. 3, 167-76(Sep 1972).

Anti-thrombocyte serum administered intraperitoneally to mice reduces thrombocyte count in 2 hrs; after 3 days the count starts to recover, reaching a maximum level on day 7 after the treatment. The injection of anti-thrombocyte serum before or after x irradiation modifies not only the extent of radiation-induced thrombocytopenia of the treated animals but also their sensitivity against the lethal effect of x rays. The extent of thrombocytopenia on day 10 post-irradiation was minimized when the antiserum was administered to mice 2 hrs or 1 day before irradiation (400 R). The survival rate of animals on day 30 was the highest when the antiserum was administered to mice 1 day before irradiation (750 R). The results suggest that the midification of radiation lethality by anti-thrombocyte serum injection is caused by the modification of thrombocyte dynamics. (auth)

56444 CHEMICAL CHANGES IN ARTERIAL AND SAGITTAL SINUS BLOOD IN NEUTRON-IRRADIATED BURROS. Wykoff, M. H. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-GEN-242. Amer. J. Vet. Res.; 33: No. 7, 1541-4(Jul 1972).

Two adult, male burros were irradiated with 300 rads of fast neutrons at the rate of 40 rads/minute. Arterial and sagittal sinus (ss) blood samples were analyzed for pH, partial pressure of O_2 (P_{O_2}), partial pressure of CO_2 (P_{CO_2}), glucose, inorganic phosphate, and chloride. Observed deviations from normal values were decreased ($P < 0.01$) P_{O_2} of arterial blood and P_{CO_2} of ss and increased ($P < 0.05$) of ss. The use of a mechanical device for obtaining blood samples from the ss was also discussed. (auth)

56445 SPONTANEOUS AND RADIATION-RELATED NEOPLASMS IN GERM-FREE MICE. Anderson, Robert E.; Doughty, William E.; Stone, Robert S.; Howarth, John (Univ. of New Mexico Albuquerque). Arch. Pathol.; 94: No. 3, 250-4(Sep 1972).

The prevalence of benign and malignant tumors was assessed in 275 germ-free and conventional female mice, a portion of which were exposed to 700 roentgens of gamma radiation at 6 weeks of age. The rate of occurrence of such tumors was considerably reduced in irradiated and nonirradiated germ-free mice, in contrast with their conventional counterparts. However, a similar comparison with respect to the age-specific mortality of animals with neoplasms suggests an accelerated appearance in the germ-free groups. (auth)

56446 EARLY CHANGES IN ACID AND ALKALINE PHOSPHATASES IN FIBROBLASTS OF β-IRRADIATED GUINEA-PIG SKIN. Chang, L. F.; Tabachnick, J. (Albert Einstein Medical Center, Philadelphia). Brit. J. Exp. Pathol.; 53: No. 3, 231-6 (Jun 1972).

In normal guinea-pig skin, fibroblasts are negative for alkaline phosphatase and demonstrate only a low level of acid phosphatase activity. One and 3 hours after 1000 to 10,000 rep β-radiation to the skin surface, dermal fibroblasts demonstrate a striking increase in the activity of alkaline and acid phosphatases. After a local dose of 3000 rep there was a biphasic increase in the activity of the phosphatases at 3 and 18 hours, with chiefly the fibroblasts in the deeper dermis being affected, then the reaction rapidly subsided. After a reduced dose (1000 rep), more fibroblasts in the superficial dermis showed increased enzyme activity. After 500 rep, the alkaline phosphatase reaction in the fibroblasts remained negative, but there was increased acid phosphatase activity. At these early intervals the alterations in phosphatase activity were limited to fibroblasts; no enzyme changes were detected in epidermis, skin appendages or blood vessels even after a dose of 10,000 rep beta-radiation. (auth)

56447 EFFECT OF GALASCORBIN ON THE AQUEOUS EQUILIBRIUM STATE IN TISSUES OF IRRADIATED RATS.

Sokolova, V. I.; Zaitseva, S. D. (Dept. of Biochemistry, Kiev). Ukr. Biokhim. Zh.; 44: No. 3, 382-5(1972). (In Ukrainian).

Aqueous equilibrium in some tissues of irradiated rats was studied as affected by galascorbin. It is found that it evokes a decrease in the total content of water in lungs, which is increased in the irradiated animals, favors an increase in the amount of intracellular water in cells of the tissues under study, correspondingly decreases their content in environments, thus having a favorable effect on cell water regime. (auth)

56448 EXPERIMENTAL X-RAY INDUCED TERATOLOGY AND THE GENERAL IMPLICATIONS. Ostertag, Berthold; Heinzmann, Ulrich (Institut fuer Hirnforschung, Tuebingen, Ger.). Aerztl. Forsch.; 26: No. 3, 87-95(10 Mar 1972). (In German).

After a short survey of the experimental x-ray induced teratology, the general problems, the experimental arrangement (a strictly hemilateral exposure of the pregnant mouse) and the irradiation effect to the early stage of development are discussed. One part deals with the behavior of the surviving irradiated animals on the eleventh day of gestation and the anatomic changes of the nervous system. Another part reports on the systemical malformation in the brain and the optic system after irradiation on the eighth day of gestation. (auth)

56449 CHANGES IN THE CONCENTRATION OF SOME PROTEINS IN RAT SERUM CAUSED BY LETHAL DOSES OF IONIZING RADIATION. Simsa, J. (Vojensky Lekarsky Vyzkummy a Doskolovaci Ustav, Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 54: 89-106(1971). (In Czech).

The methods of quantitative immunoelectrophoresis and simple radial immunodiffusion were used to study the changes of albumin, alpha$_1$-lipoprotein, alpha$_2$-globulin, ceruloplasmin, haptoglobin, beta-globulin, hemopexin, transferrin and IgG in rats (male and female) after whole-body irradiation with 900 and 1200 R. The levels of albumin, alpha$_1$-lipoprotein and IgG decreased. The concentrations of the other proteins increased, except of transferrin. After exposure to 900 R the level of transferrin slightly decreased and after 1200 R slightly increased. These changes were not statistically significant. Changes of albumin, alpha$_1$-lipoprotein, and IgG after exposure to 1200 R were less pronounced as compared to 900 R, probably due to early death of the rats. (auth)

56450 GASTROINTESTINAL SYNDROME IN GERM-FREE PIGLETS. Moravek, F.; Mandel, L.; Miler, I. (Vojenksy Lekarsky Vyzkumny a Doskolovaci Ustav J. E. Purkyne, Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 54: 107-19(1971). (In Czech).

Observations were made on differences in the structure of the intestinal mucosa of non-irradiated germ-free and conventional new-born piglets; on survival, morphological changes, and gastrointestinal syndrome in animals following a supralethal exposure to 959 rads; and on the effects of contamination of germ-free piglets with Escherichia coli following exposure to 959 rads. It was found that the survival time of germ-free piglets was higher than that of conventional animals. The significance of the results is discussed. (H.L.W.)

56451 COLLABORATION BETWEEN THYMUS-DERIVED AND MARROW-DERIVED THORACIC DUCT LYMPHOCYTES IN THE HEMOLYSIN RESPONSE OF THE RAT. Scott, David W.; Howard, Jonathan C. (Oxford Univ.). Cell. Immunol.; 3: 430-41(Mar 1972).

Thymectomized (Tx), irradiated hooded rats, reconstituted with 200×10^6 syngeneic normal bone marrow cells, showed variable responsiveness to challenge with sheep red blood cells (SRBC) at four and eight weeks after irradiation. If Tx recipients were restored instead with only 10×10^6 marrow cells from lymphocyte-depleted (i.e. thymectomized, thoracic duct-drained) donors, these rats were unresponsive to SRBC challenge at four weeks. Injection of 200×10^6 syngeneic thymus cells into such rats restored the hemolysin response to SRBC and the antibody was made by marrow-derived cells. Thoracic duct lymphocytes obtained from Tx irradiated rats reconstituted with lymphocyte-depleted marrow were able to transfer responsiveness to this antigen to irradiated secondary recipients if thymocytes were injected one week or more before cannulation. The restoration of competence in the thoracic duct population required the presence of thymus-derived cells but all antibody made in secondary recipients was synthesized by marrow-derived cells. It is argued that the competence of normal thoracic duct lymphocytes is due to the presence of a mixture of thymus-derived and marrow-derived cells. (auth)

56452 ULTRASTRUCTURAL INJURY FOLLOWING X-IRRADIATION OF RAT PAROTID GLAND ACINAR CELLS. Pratt, N. E.; Sodicoff, M. (Temple Univ., Philadelphia). Arch. Oral Biol.; 17: No. 8, 1177-86(Aug 1972).

Following x-irradiation with 1600 rad to the head and neck area of rats, parotid glands were examined at 1, 3 and 5 hr, and 1, 2, 3, 4, 7 and 8 days for evidence of ultrastructural damage of acinar cells. Damage was evident as early as 3 hours with maximum destruction seen at 2 days. Ultrastructural damage took the form of cytolytic bodies composed of damaged cell organelles and structures called light bodies which may represent autophagic vacuoles to be finally extruded from the cell of inflammatory cells which have invaded the cell. At the 7- and 8-day interval, the most prominent alteration of cellular architecture was the presence of many empty vacuoles. The study demonstrates the early onset of observable damage with doses as low as 1600 rad. (auth)

56453 EFFECT OF NOVEMBICHIN OF THE DEVELOPMENT OF LEUCOSIS AND A THYMIC FORM OF RETICULOSIS IN IRRADIATED MICE. Aleksandrov, S. N.; Galkovskaya, K. F. (Central Scientific-Research Rentgenoradiological Inst., Moscow). Vop. Onkol.; 18: No. 6, 46-50(1972). (In Russian).

Injections of nonblastomogenic doses of novembichin in nonbred mice, subjected to fractional irradiation, markedly increased the incidence of myeloid leukosis but render no effect on that of a thymic form of reticulosis. The mentioned leukosogenic effect of this agent is absent in its administration in animals, subjected to continuous effect of ionizing radiation with a low-voltage dose (87 mR/m). The peculiarities of potential leukosogenic changes occurring under the influence of radiation and revealed in some additional effect are discussed. (auth)

56454 EVALUATION OF THE UTILIZATION OF ANIMALS EXPOSED TO LETHAL LEVELS OF IONIZING RADIATION. Eisele, Gerhard R. Knoxville, Tenn.; Univ. of Tennessee (1972). 72p. University Microfilms Order No. 72-21,348.

Thesis.

Animals exhibiting visible signs of radiation sickness could be an important food resource in the event of a nuclear disaster. Market hogs (Sus scrofa domestica) weighing approximately 200 to 250 lbs were exposed to a total air dose of 700 R at a rate of 1 R or 45 R/min of gamma radiation from a ^{60}Co source. Bacteriological studies were conducted on pre- and post-irradiation blood specimens. Muscle, liver and mesenteric lymph nodes were cultured for bacteria 10 days post-irradiation when the animals were slaughtered, and muscle samples were cultured again 5 days post-slaughter during which time the carcasses had hung in a cooler. Samples of the teres major muscle were taken at the above times for the following chemical analyses: crude protein, soluble protein, ether extract, moisture content and pH. Cooked loins from carcasses of irradiated and control animals were subjected to sensory panel evaluations. A bacteremic state was not detected in the 1 R/min group nor was there a greater incidence of bacterial isolates from the carcasses of irradiated animals as compared to those from the control animals. Staphylococcus aureus was one of several organisms recovered from the meat. Since several strains are capable of producing an enterotoxin, the safety of the meat for consumption is questionable since no tests are available to rapidly identify these strains. The results of determination of chemical properties indicated no significant differences in ether extract, moisture content, crude protein or soluble protein. The pH of the meat from irradiated animals at slaughter was significantly higher ($P < 0.05$) than that of control meat. During the storage phase the pH decreased significantly ($P < 0.01$). Taste panel evaluations indicated no drastic flavor differences due to treatment. However, color was significantly affected. All animals exposed to 45 R/min developed a bacteremia at least once during the 10-day post-irradiation period, but this bacteremia was not consistent within the group. Bacterial isolates from the muscles of irradiated animals at slaughter and 5 days later were consistently higher than isolates from controls. These bacteria represented an increased number of genera. Because of the possibility of non-specific and staphylococcal food poisoning, it is recommended that this meat not be consumed. Muscle from irradiated animals yielded significantly more ether extract at slaughter ($P < 0.05$) and after 5 days storage, while moisture content was significantly lower ($P < 0.05$) at both times. A significant reduction ($P < 0.01$) in soluble protein was noted during the storage phase. Muscle from irradiated animals again yielded significantly higher pH values ($P < 0.05$), but no difference was noted after the storage phase. Taste panel evaluations indicated less treatment effect on both flavor and color than observed in the low dose rate group. (Diss. Abstr.)

56455 RADIATION CONDITIONS IN THE HOMES AND REFUGES OF MURIFORM RODENTS IN BIOGEOCENOSES WITH A HIGH NATURAL RADIATION BACKGROUND. Maslov, V. I. pp 216-26 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Investigations were carried out that showed that owing to their close and direct contact with surface soil layers burrowing animals, and in particular the tundra vole Microtus oeconomus P., are more affected by ionizing radiation even at a slight increase of the radioactive background, as compared with other mammal species inhabiting the same territories, being more attached to the burrow. It was found that under conditions of a uranium–radium biogeocenosis the radioactive background of the homes and refuges of muriform rodents exceeds by 100 to 1000 times that of regions with a normal radiation level. It is shown that the animals are exposed to the highest doses of radiation during the summer period because of the radiations created in the burrows. Tundra voles that are permanently living under conditions of a high radiation background and have no capacity for selecting habitats with normal radiation conditions were found to acquire some new ecological traits displayed in the arrangement of their homes and refuges. (auth)

56456 LEUKOCYTIN: A NEW MEANS OF TREATING RADIATION-INDUCED LEUKOPENIA. Gorizontov, P. D.; Kalyaeva, T. V.; Rogozkin, V. D. Patol. Fiziol. Eksp. Ter.; 15: 54-9(1971). (In Russian).

Experiments were performed on totally x-irradiated rabbits (a dose of 450 to 500 R) and dogs (a dose of 400 R). A study was made of a new preparation containing glucoalkaloid salonin and conditionally named leucocytin. The preparation was given orally to rabbits in a dose of 15 ml, and to dogs in a dose of 30 mg every other day. The extent of leucopenia and of degenerative changes in the haemopoietic organs was reduced, mitotic activity was preserved, and regeneration of haemopoietic cells was accelerated. Leucocytin can be recommended for the treatment of leucopenias in acute forms of radiation sickness, and apparently, for certain leucopenias of other etiology. (auth)

56457 DIFFERENCE IN HAEMOPOIETIC STEM-CELL REPOPULATION AFTER D–T NEUTRON OR X-IRRADIATION. Hendry, J. H. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 22: No. 3, 279-83(Sep 1972).

The regeneration patterns of hemopoietic colony-forming units (CFU) in the femora and spleens of x-irradiated (450 rads) or neutron-irradiated (350 rads) mice were determined. In both hemopoietic sites, the CFU doubling-time was greater after neutrons than after x-rays. The results are discussed in relation to radiotherapy. (auth)

56458 PROTECTION OF THE WHOLE-BODY IRRADIATED RATS BY SIMULTANEOUS INTERPERITIONEAL CYSTAMINE ADMINISTRATION AND SHORT-TERM ISCHEMIZATION OF LEGS. Vodicka, I. (Vojensky Lekarsky Vyzkumny a Doskolovaci Ustav, Hradec Kralove, Czech.). Sb Ved. Pr. VLVDU Hradci Kralove; 54: 77-87(1971). (In Czech).

The protective effect of cystamine, ligation of both legs, and of the combination of both these means was investigated in female rats whole-body lethally irradiated from a ^{60}Co γ source. In addition to that, the influence of barbital narcosis alone was studied on the radiosensitivity of rats and on the protective action of cystamine. The combination of cystamine and ischemization of legs protected irradiated rats better than each of both means alone. Using this combination, a protection was obtained, corresponding to DRF = 1.61, while by means of the tourniquet protection, DRF = 1.40. Barbital narcosis did not influence the radiosensitivity of rats judged according to their 30 days lethality, but it lowered distinctly the protective effectiveness of cystamine. (auth)

56459 PRACTICAL VALUE OF THE RED BLOOD CELL SPECTRUM DURING POST-ANEMIA RECOVERY PROCESSES. STUDY OF THE SUBLETHALLY IRRADIATED RAT. Le Go, A.; Le Go, R.; Malarbet, J. L.; Prudhomme, J. (Hopital Cochin, Paris). Nouv. Rev. Fr. Hematol.; 12: No. 2, 139-58(Mar 1972). (In French).

The red blood cell spectrum was used to investigate the dynamics of the red blood cell populations of rats following a whole-body exposure to 725 R of gamma radiation. Three elementary component curves were established from the experimental curves using a FORTRAN fitting program. Factorial analysis was used to establish correlations between the theoretical population percentages and the hematological parameters: red blood cell count (RBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), and the reticulocyte count. A good correlation was found between the RBC and the MCHC for the normocytic population and between the reticulocyte and the MCV for the megacytic population. In spite of the intervention of the well known Coulter effect on the erythrocyte spectrum morphology, this method appears to be a valuable tool for studying the dynamics of the macrocytic response during the recovery from anemia. (France)

56460 RELEASE OF THIOLS FROM CELLULAR MIXED DISULPHIDES AND ITS POSSIBLE ROLE IN RADIATION PROTECTION. Modig, H. G.; Edgren, M.; Revesz, L. (Karolinska Institutet, Stockholm). Int. J. Radiat. Biol.; 22: No. 3, 257-68(Sep 1972).

The non-protein-bound part of Ehrlich ascites tumor cell mixed disulphides between proteins and thiols was analyzed by gel-filtration after reduction of the disulphide bonds. Glutathione (GSH) was found to be the only detectable low-molecular thiol bound to cellular proteins. Reduction of disulphide bonds resulted, in addition to the release of GSH, in the liberation of sulphydryl-containing protein fragments of various sizes. Using cells in which the sulphur was labeled with ^{35}S, it was demonstrated that about 15% of the incorporated cysteamine was bound to the proteins, and the GSH was released in comparable amounts. The protein-cysteamine bound was stable for at least 95 min. It is concluded that GSH is released from proteins by cysteamine treatment in an exchange reaction. The data suggest, furthermore, that protein-bound GSH may be regarded as a reservoir of a radioprotective substance that can be released under certain conditions, and, when released, can contribute to enhance the radioresistance of cells. (auth)

56461 RADIATION PROTECTION BY TIBIA-SHIELDING IN ADULT, WEANLING, AND SUCKLING MICE. I. COMPARATIVE PROTECTION STUDIES. Rauchwerger, J. M. (Baylor Univ., Houston, Tex.). Int. J. Radiat. Biol.; 22: No. 3, 269-78 (Sep 1972).

Of three age-groups of (C3H × C57BL)F_1 mice that were x-irradiated over a dose range 0 to 1500 rad, 12-week-old adults were found to be less radiosensitive than either 4-week-old weanlings or 1-week-old sucklings. An attempt was made to protect all age-groups against hemopoietic death by unilateral tibial shielding. Results showed that sucklings could be protected as well as adults. However, weanlings, which had the greatest radiosensitivity, could not be protected as well. This was found to be correlated with an increased radiosensitivity of the gastrointestinal system. Gut death occurred in weanlings at 3 to 6 days after x-ray exposures that were closer than those of either adults or sucklings to their hemopoietic LD/50 (30). (auth)

56462 RADIATION PROTECTION EFFECT OF ANTIPHEIN FOR FRACTIONATED RADIATION DOSES. Stashkov, A. M. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal, Navuk; No. 3, 100-3(1972). (In Russian).

In fractional x-radiation experiments on white mice, an increase in the survival rate of 55 to 60% was observed (as compared with control animals) when antiphein was administered (100 mg/kg) prior to irradiation. The optimum regimen was the administration of 100 mg/kg before each half (375 R) of the total (lethal) dose of 750 R. (K.S.W.)

56463 QUINACRINE FLUORESCENT CHROMOSOME ANALYSIS OF THE SNELL TRANSLOCATION IN THE MOUSE. Miller, D. A. (Columbia Univ., New York); Allderdice, P. W.; Kouri, R. E.; (and others). Genetics; 71: No. 4, 633-7(Aug 1972).

The chromosomes involved in the T(2;4)Sn (formerly designated T(5;8)Sn) or Snell-radioinduced translocation in the mouse have been identified as numbers 2 and 4 by analysis of the fluorescent banding patterns of quinacrine mustard-stained chromosomes in primary cultures from heterozygous and homozygous embryos. (auth)

56464 BASIC QUESTIONS IN RADIOBIOLOGY. Hajdukovic, S. (Bioloski Institut, Belgrade); Szirmai, E. J. Inst. Nucl. Eng.; 13: No. 4, 111-14(Jul 1972).

Among the matters discussed are: the nature of ionizing radiation; manner of action; mechanism of action; dosimetry; and time factors involved. Hematological experiments with mice and hematological studies of accidentally irradiated men are described as well as the effects of irradiation on human chromosomes. (UK)

56465 LIPID METABOLISM IN CONTINUOUSLY IRRADIATED RATS. I. EFFECT OF NICOTINIC ACID IN FED ANIMALS. Ahlersova, E.; Ahlers, I.; Sedlakova, A.; Tothova, E.; Praslicka, M. (Safarik Univ., Kosice, Czech.). Biologica (Bratislava); 26: No. 12, 887-91(1971).

Nicotinic acid was found to significantly decrease the concentrations of free fatty acids in the serum, the white and brown adipose tissues, in the liver, and in the heart muscle of fed rats exposed to continuous gamma irradiation (60 R daily, total exposure of 1500 R) on an open experimental field. A concomitant decrease in the serum triglycerides was also observed in the irradiated animals. Post-irradiation hyperlipemia was found to be significantly influenced by nicotinic acid administration. (NSA of Czech.)

56466 EFFECT OF DOSE RATE ON MITOTIC INDEX, METAPHASE TO PROPHASE RATIO, AND RATE OF CHROMOSOMAL ABERRATIONS IN REGENERATING RAT LIVER. Kropacova, K.; Misurova, E.; Praslicka, M. (Safarik Univ., Kosice, Poland). Biologica (Bratislava); 26: No. 12, 893-9(1971).

Ionizing radiation was shown to induce damage in the rat liver which, after partial hepatectomy, was manifest in an increased rate of chromosomal aberrations and in an inhibited mitosis. This was evidenced by a decreased MI and a changed M/P ratio. The extent of alterations resulting from single irradiation exponentially depended on the dose. The extent of the mitosis inhibition and of the rate of chromosomal aberrations resulting from continuous irradiation was affected by the dose rate. A dose of single irradiation was shown to induce greater damage than a similar dose applied in the form of continuous irradiation. For continuous irradiation over 16.5 days at a dose rate of 40 R the dose reducing factor (DRF) was found to be 3.3; this decreased with increasing the dose rate and dropped to 1.7 at a dose rate of 660 R/days. (NSA of Czech.)

56467 EFFECTS OF CONTINUOUS GAMMA IRRADIATION ON DEOXYRIBONUCLEOPROTEIN OF LYMPHATIC AND HEMATOPOIETIC TISSUES. Misurova, E.; Mackova, N.; Misur, M.; Praslicka, M. (Safarik Univ., Kosice, Czech.). Biologica (Bratislava); 26: No. 12, 901-8(1971).

The concentration of deoxyribonucleoprotein (DNP) and the amount of polydeoxyribonucleotides released from DNP during continuous irradiation at a daily dose rate of 1, 10, 50, and 100 R, respectively, were studied in the spleen, thymus, and bone marrow of rats. The animals were sacrificed on the 1st, 3rd, 10th, 20th, 40th, and 60th day of irradiation. Continuous irradiation with lower daily dose rates (1 and 10 R) resulted in a temporary decrease in the DNP concentration without a significant increase in the amount of free polydeoxyribonucleotides. Higher dose rates (50 and 100 R) resulted in an increased amount of polydeoxyribonucleotides that lasted till the 40th day. The DNP concentration was permanently reduced. (NSA of Czech.)

56468 EFFECT OF COMBINATION OF CONTINUOUS GAMMA IRRADIATION AND RESTRAINT ON SERUM AND TISSUE LIPIDS IN RAT. Sedlakova, A.; Ahlersova, E.; Ahlers, I.; Praslicka, M. (Safarik Univ., Kosice, Czech.). Biologica (Bratislava); 26: No. 12, 909-13(1971).

Continuous exposure of rats to γ irradiation on an open experimental field with a total dose of 1500 R, at a dose rate of 60 R/day did not considerably modify a common stress type of reaction of serum and tissue lipids and of blood glucose during subsequent short-term restraint. (NSA of Czech.)

56469 X-RAY AND PROTON INDUCED LENS CHANGES IN THE RABBIT. Cleary, S. F.; Geeraets, W. J.; Williams, R. C.; Mueller, H. A.; Ham, W. T. (Medical Coll. of Virginia, Richmond). Health Phys.; 23: No. 4, 453-9(Oct 1972).

Opacification of the rabbit lens was studied as a function of dose (0 to 1000 rads) and time after irradiation with 1-MeV x rays and 20- and 100-MeV protons. The degree of opacification was dependent upon time, radiation dose and LET. Twenty MeV protons produced the greatest relative lens damage. The relative biological effectiveness (RBE) was determined for the 20 and 100 MeV protons relative to 1 MeV x-ray induced lens changes. The RBE was found to increase with LET. (auth)

56470 EFFECT OF X-RADIATION ON SALIVARY GLAND GROWTH IN THE RAT. IV. RELATIVE EFFECTS OF LOCAL IRRADIATION ON GROWTH, REGRESSIVE, AND SECRETORY PHASES OF SIALADENOTROPHISM. Van Den Brenk, H. A. S.; Stone, M. G. (Saint Thomas' Hospital, London). Int. J. Radiat. Biol.; 22: No. 3, 205-23(Sep 1972).

Adaptive growth of salivary tissues in the rat (growth phase of sialadenotrophism), induced by treatment with isopropylnoradrenaline (ISOP), was principally due to the hypertrophy of acinar cells assisted by a relatively short and limited phase of acinar-cell hyperplasia (cell division) causing corresponding increases in total glandular DNA. This hyperplastic component of growth was sensitive to x-rays over a range 0 to 1500 rads. Increases in glandular protein and RNA due to cell hypertrophy were radioresistant. Decreases in gland-weight, protein, RNA and DNA, which occurred rapidly after treatment with ISOP had been terminated (regression phase), were due to regression of cell hypertrophy and loss of supernumerary acinar cells that had accumulated during the growth phase. Local irradiation (1500 rads) failed to affect the rates of regression of hypertrophy and cell loss. Secretion and resynthesis of salivary enzyme (amylase) by parotid glands, which had become enlarged in rats treated with ISOP, were similarly radioresistant. (UK)

56471 EFFECT OF CONTINUOUS GAMMA IRRADIATION ON SERUM AND TISSUE LIPIDS IN RATS. Ahlers, I.; Ahlersova, E.; Sedlakova, A.; Praslicka, M. (Safarik Univ., Kosice, Czech.). Biologia (Bratislava); 26: No. 12, 881-6(1971).

A significant increase in serum and some tissue lipids and an increase in blood glucose were observed in rats after continuous gamma irradiation on an open experimental field with daily doses of 60 R for over 25 days (with a total dose of 1500 R). A certain role in the pathogenesis of the changes could be played by an increased lipomobilization. Only partial repair of the radiation-induced changes in the serum and tissue lipids was observed a week after the irradiation. (NSA of Czech.)

56472 SURVIVAL OF ^{51}Cr-LABELED ERYTHROCYTES FOLLOWING IRRADIATION AND ADMINISTRATION OF AET. Dienstbier, Z.; Pospisil, J.; Prouza, Z. (Charles Univ., Prague). Bratislav. Lek. Listy; 56: No. 4, 385-90(Oct 1971). (In Czech).

The effect of the radioprotective substance AET BrHBr on the half-life survival of rat erythrocytes following whole-body x irradiation was studied using ^{51}Cr-labeled erythrocytes. AET was shown to favorably affect the half-life survival of erythrocytes following irradiation in that it shifted the reduced values of half-life resulting from irradiation back towards normal. (NSA of Czech.)

56473 RADIATION PROTECTION BY 2-MERCAPTOPROPIONYLGLYCINE IN MICE. Nagata, H. (National Kyoto Hospital); Sugahara, T.; Tanaka, T. J. Radiat. Res.; 13: No. 3, 163-6(Sep 1972).

A new sulfhydryl compound, 2-mercaptopropionylglycine, which is commercially available in Japan as a detoxicating agent, has been shown to be protective in mice against lethal doses of ionizing radiation at a very low dose of 20 mg/kg, far below its toxic dose of more than 2,900 mg/kg. The drug has an optimum dose for protection, 20 mg/kg, and its protection continues more than 3 hrs, though with a less extent after 1 hr than within 1 hr. The results suggest a clue to the mechanism of sulfhydryl radioprotectors and give promise of clinical application. (auth)

56474 CONCENTRATION OF LIPOPEROXIDES AND DEOXYRIBONUCLEOPROTEIN IN LIVER, KIDNEYS, AND HEART MUSCLE OF CONTINUOUSLY IRRADIATED RATS. Sedlakova, A.; Misurova, E.; Ahlersova, E.; Ahlers, I.; Praslicka, M. (Safarik Univ., Kosice, Czech.). Biologica (Bratislava); 26: No. 12, 915-19(1971).

Continuous exposure of rats to gamma irradiation on an open experimental field with daily dose rates of 60 R over 25 days significantly increased the concentration of lipoperoxides in the liver, decreased the concentration of deoxyribonucleoprotein in the heart muscle and the kidneys, and increased the concentration of free deoxyribonucleotides in the heart muscle. The administration of nicotinic acid did not influence the content of lipoperoxides in the tissue but significantly decreased the concentration of free deoxyribopolynucleotides in the heart muscle. (NSA of Czech.)

56475 STUDY OF CHROMOSOME REARRANGEMENTS PRODUCED IN SPERMATOGONIA OF RATS AND MICE BY X IRRADIATION. Gilliavod, N.; Leonard, A. (CEN, Mol, Belgium). Can. J. Genet. Cytol.; 14: No. 2, 341-5(Jun 1972). (In French).

Adult male BALB/c mice and adult male Wistar rats were given whole-body x irradiation with 300 R. Irradiated and control animals were killed after 120 days to study in dividing spermatocytes the rate of translocation induced in spermatogonial stages. No significant difference was recorded between the two species with respect to the rate of cells with translocation configurations. (auth)

56476 PREFERENTIAL SENSITIZATION OF HYPOXIC CELLS TO RADIATION IN VIVO. Denekamp, J.; Michael, B. D. (Mount Vernon Hospital, Northwood, Eng.). Nature (London) New Biol.; 239: No. 88, 21-3(6 Sep 1972).

A technique is described for producing radiobiological hypoxia in albino mice skin and preferentially sensitizing the anoxic cells. The method was used for testing the radiosensitizing properties of N-dimethylparanitro-2-propiophenone (NDPP). The degree of sensitization in hypoxic cells was proportional to the dose of NDPP, over a dose range of 0 to 5 mg/mouse of NDPP and an electron radiation dose range of 0 to 5.5 krad. Enhancement ratios (ER) for the survival of epidermal clones varied from 1.06 to 1.52 and were affected by the method of administration and strain of mouse. For animals given 1 mg NDPP and irradiated in O_2, a slight degree of protection was observed. Administration of the drug was limited by its toxicity, that could be reduced by subdividing the dose into a series of intraperitoneal injections. (UK)

56477 PHAGOCYTIC ACTIVITY OF THE MICROPHAGOCYTES IN THE BLOOD IN IRRADIATED ANIMALS. Moscicka, Maria; Marczak-Sokolowska, Krystyna (Inst. of Hematology, Warsaw). Acta Physiol. Pol.; 22: No. 6, 884-95(1971). (In Polish).

The phagocytic activity of leukocytes in the blood of rabbits exposed to high doses of ionizing radiation (500 R of x radiation) was investigated. The results revealed that the phagocytic activity index of the leukocytes of nonirradiated rabbits was 12.61; the ratio of phago-active leukocytes amounted to 90% while the white blood cell count was 10,120/mm^3. Exposure to 500 R increased significantly the phagocytic activity of the leukocytes at 30 days after irradiation; simultaneously the ratio of phagoactive leukocytes was increased by 16% and the white blood cell count was decreased by 37% with respect to the initial values. The phagocytic activity index of the leukocytes of the irradiated rabbits was increased considerably. (TTT)

Invertebrates

Refer also to abstracts 56329, 56355, and 56391.

56478 RELATIONSHIP BETWEEN INSECT MINERAL CONTENT AND RADIATION SENSITIVITY. Levy, Richard. Gainesville, Fla.; Univ. of Florida (1971). 155p. University Microfilms Order No. 72-21,078.

Thesis.

Parts per million insect total body copper, iron, magnesium, sodium, and potassium were analyzed by atomic absorption spectrophotometry to determine if mineral content could be used as an effective biological indicator for a species-specific dose of ionizing radiation. Simple and multiple regression analysis of 22 species of adult insects representing Anoplura, Coleoptera, Diptera, Hemiptera, Homoptera, Lepidoptera, Orthoptera and Thysanura indicated that there was a direct relationship between tissue-organ cation content and x-ray or gamma radiation sensitivity as defined by the $LD_{50/24\ hour}$, $LD_{50/28\ day}$, and $LD_{50/mean\text{-}mortality}$ dose parameters. $LD_{50/24\ hour}$ regression models were shown to be highly correlated to insect feeding preferences. Mechanisms of death were postulated as being activated by oxidation and binding of mineral cations from high doses of ionizing radiation, with the subsequent inhibition of the CNS, and/or the inhibition of respiratory metabolism. Analysis of $LD_{50/28\ day}$ and $LD_{50/mean\text{-}mortality}$ regression models appeared to indicate a species response to low doses of ionizing radiation via free radical inhibition of an integrated series of biological functions involving the CNS, respiratory system, circulatory system, buffer systems, tyrosinase enzyme system, RNA synthesizing system, and digestive-excretory systems. Several mechanisms for radiation-induced delayed death were postulated. Although no LD_{50} values were available for developing regression models based on larvae, pupae, or nymphs, their mineral content did demonstrate characteristic differences when compared to the adult stages. Therefore, it would seem that specific mechanisms for characterizing their radiation sensitivity according to life cycle stage could be developed. In all, 39 species of adults, 12 species of larvae, 5 species of pupae, and 3 species of nymphs were analyzed by atomic absorption spectrophotometry for insect total body Cu, Fe, Mg, Na, and K content in parts per million. (Diss. Abstr.)

56479 GAMMA RADIATION EFFECTS ON TESTES AND ON MATING SUCCESS OF THE INDIAN MEAL MOTH, PLODIA INTERPUNCTELLA. **Ashrafi, Shahid H.; Brower, John H.; Tilton, Elvin W. (Dept. of Agriculture, Savannah). Ann. Entomol. Soc. Amer.; 65: No. 5, 1144-9(Sep 1972).**

Fifth-stage male larvae and 1-day-old male adults of the Indian meal moth, Plodia interpunctella (Hübner), were treated with gamma radiation. Histological observations on the testes and spermatogenic material were made, and the mating success of paired irradiated males and nonirradiated females was determined. In larval tests, spermatogonia were found to be most sensitive to radiation, followed by spermatocytes, and then spermatids. Damage to all stages increased with increasing radiation dose. Larvae treated with 3.5 krad developed normally, and mating behavior and sperm transfer to females were normal. Previous work has shown that genetic damage, as evidenced by decreased progeny production, was transmitted through several generations. When adult males were treated with 25 krad, sperms appeared unaffected but progeny production in the 1st generation was reduced. However, this effect did not carry over into 2nd and 3rd generations. (auth)

56480 CAUSES OF DEATH IN IRRADIATED ADULT INSECTS. **Ducoff, H. S. (Univ. of Illinois, Urbana). Biol. Rev. Cambridge Phil. Soc.; 47: No. 2, 211-40(May 1972).**

An extensive literature review is made of the radiation effects in insects compared with mammals. The evidence discussed shows that in many orders death occurs during a limited period, the beginning and duration of which are independent of dose over a wide range, suggesting the operation of a specific lethal syndrome. Examples from three species of beetles are used. However, it is pointed out that in Diptera and many moths, either the absence of somatic-cell division, or the short life of the imago prevents the development of this syndrome, and these groups require higher radiation doses for demonstrable mortality, the time course of which is closely related to dose. Other topics discussed are: damage to the insect midgut, with reference to the mammalian intestinal syndrome; the effects of the nervous system and their possible relationship to insect supralethal irradiation; response of insects to disease resistant mechanisms; quantitative information on the response of insect cells; and apparently beneficial effects of radiation. (UK)

56481 INTERACTION OF AGE AND RADIATION DOSAGE ON HATCH OF GIBBIUM PSYLLOIDES EGGS (COLEOPTERA: PTINIDAE). **Brower, John H. (Dept. of Agriculture, Savannah). Ann. Entomol. Soc. Amer.; 65: No. 5, 1237-8(Sep 1972).**

Eggs of the spider beetle were collected from stock cultures for 13 days and gamma-irradiated 12 hr after collection at doses of 0 to 80 krad. Eggs were observed daily for hatching and larvae were counted and removed. One-, two-, and three-day old eggs were very sensitive, and sensitivity increased slightly as age increased from one to three days. Three-day old eggs were the most sensitive of any age. Radiation sensitivity decreased as age increased from three to eleven days. (H.L.W.)

56482 ROLE OF SULFHYDRYL GROUPS IN RADIOSENSITIVITY OF SILKWORM EGGS. Semerdzhyan, S. P.; Nor-Arevyan, N. G.; Sarkisyan, S. M.; Megroyan, Sh. G. Biol. Zh. Arm.; 24: No. 10, 83-4(Oct 1971). (In Russian).

Silkworm eggs which incubated at 26°C were exposed to gamma rays on the 1st, 3rd, 6th, and 10th day after the start of the incubation period. A schedule of 17 dose levels was used, ranging from 100 to 25,000 R. The percent not hatching after 15 days of incubation was the criterion of the radiological effect for each group of eggs. Total sulfhydryl content was measured by amperometric titration. Embryos in earlier stages of development were more sensitive than later ones. The anticipated direct association between embryo development and acid-soluble thiol content in the incubated eggs was substantiated. (K.S.W.)

56483 STERILITY ENHANCEMENT IN THE MOSQUITO, CULEX TRITAENIORHYNCHUS. Sakai, Richard K.; Baker, Richard H.; Mian, Afsar; Said, Shahina (Pakistan Medical Research Center, Lahore). Can. J. Genet. Cytol.; 14: No. 2, 215-20(Jun 1972).

The sterilities of stocks of mosquitos with chromosomal aberrations were enhanced by re-irradiation. Males heterozygous for two independent aberrations were synthesized and their sterilities determined. The possible advantages of the double heterozygote males over either completely sterile males or those heterozygous for only one aberrational complex are discussed. (auth)

56484 COMBINED EFFECTS OF EGG AGE AND RADIATION DOSAGE ON EGG HATCH OF TENEBRIO MOLITOR (COLEOPTERA: TENEBRIONIDAE). Brower, John H. (Dept. of Agriculture, Savannah, Ga.). Can. Entomol.; 104: No. 1, 141-4(Jan 1972).

Tenebrio molitor L. eggs in 15 age groups ranging from 0.5 to 7.5 days were irradiated with 10 dosages of gamma radiation ranging from 0.5 to 160 krad. The study showed that age had a pronounced effect on radiation-induced egg mortality. There was a 250-fold increase in resistance as eggs matured from 0.5 to 7.5 days as measured by the dosage required to produce an LD_{50}. (auth)

56485 INHERITED STERILITY AND POSTEMBRYONIC SURVIVAL OF TWO GENERATIONS OF TOBACCO BUDWORMS, HELIOTHIS VIRESCENS (LEPIDOPTERA: NOCTUIDAE), FROM PARTIALLY STERILE MALES. Proshold, F. I.; Bartell, J. A. (Dept. of Agriculture, Fargo, N. Dak.). Can. Entomol.; 104: No. 2, 221-30(Feb 1972).

Male Heliothis virescens (F.) were irradiated with 7.5, 15.0, or 22.5 krad of γ rays and crossed with untreated females. Then fertility of these treated males (P_1) and of their descendants was studied for two generations. In addition, the postembryonic survival of the F_1 and F_2 generations was studied. Fertility (percentage egg hatch) of P_1 males was greater than that of F_1 males or F_1 females. There was more postembryonic survival in the F_1 than in the F_2 generation. When the P_1 males received 22.5 krad, few F_2 larvae hatched, and none survived. When P_1 males received 15.0 krad, the fertility of F_1 males and females was less than 5 and 10%, respectively, and less than 20% of the F_2 larvae survived; however, sterility factors were nearly eliminated by the third generation. When P_1 males received 7.5 or 15.0 krad, the average fertility of F_2 males was greater than that of F_1 or P_1 males but less than that of untreated controls, though fertility of some F_2 males was normal. The lower the dose received by P_1 males, the greater was the frequency of F_2 males with normal fertility. (auth)

56486 POSTEMBRYONIC GROWTH AND DEVELOPMENT OF F_1 AND F_2 TOBACCO BUDWORMS (LEPIDOPTERA: NOCTUIDAE) FROM PARTIALLY STERILE MALES. **Proshold, F. I.; Bartell, J. A. (Dept. of Agriculture, Fargo, N. Dak.). Can. Entomol.; 104: No. 2, 165-72(Feb 1972)**

Tobacco budworms, Heliothis virescens (F.), with inherited sterility caused by irradiation of the male parent were smaller than progeny from normal parents and developed more slowly throughout the larval and pupal periods. In the second generation the population segregated into two groups, those with normal and those with delayed development. Also, when the P_1 male received 15.0 krad, 8% of the F_1 larvae had more than the normal five instars. Moreover, when those F_1 progeny that had only five larval instars were outcrossed to normal moths, this tendency for supernumerary molts increased nearly 3-fold. The slower development of progeny of treated moths would have to be considered in field tests made to evaluate the effect of inherited sterility on the tobacco budworm. However, with continuous release of irradiated males, the delayed development of smaller size of the progeny should not lessen the possibility that this method could successfully suppress field populations. (auth)

Radionuclide Effects (Internal Source)

56487 (NIRS-Pu-7) RESEARCH REPORT "ON INTERNAL EXPOSURE TO PLUTONIUM" IN APRIL 1969–MARCH 1970. (National Inst. of Radiological Sciences, Chiba (Japan)). 1 Oct 1970. vp. (In Japanese). NTIS (U. S. Sales Only).

Separate abstracts were prepared for 19 sections. (M.C.G.)

For abstracts of individual sections see: 55741, 55742, 55900, 55932, 56168–56171, 56488, 56508, 56542–56549, and 56784.

56488 (NIRS-Pu-7, pp 81-9) IN VIVO ACTION OF PLUTONIUM AND ITS BIOLOGICAL EFFECTS. Eto, Hideo (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

This review is based on the lecture given at the Symposium on Threshold Dose for Safety Estimation of Plutonium Reactor, sponsored by the Section on Health Physics, Atomic Energy Society of Japan (November 1, 1969 at Sendai City). Consideration is given only to the case of inhalation contamination of plutonium from the viewpoint of safety estimation. The topics discussed include: inhalation and metabolism of plutonium (14 refs); and radiation effects and their relation to dose, specifically in the lungs (38 refs), liver (17 refs), and bones (12 refs). The literature reviewed covers the period of the last ten years. (Japan)

Man

Refer also to abstracts 56168, 56201, and 56410.

56489 EVALUATION OF DOSE COMMITMENT FOR INDUSTRIAL TRITIUM WORKERS. Dunster, H. J.; Stradling, G. N. (National Radiological Protection Board, Harwell, Eng.). Brit. J. Radiol.; 45: No. 537, 710(Sep 1972).

Previous criticisms [Br. J. Radiol.; V.45(537), p.708 (Sep 1972)] of the ICRP terms "investigation" and "negligible" levels are discussed in relation to dose commitments for industrial tritium workers. It is suggested that the ICRP "investigation" level should be split into (1) a recording level above which the monitoring service provides a numerical result and, for urine analysis, interpretation in terms of dose commitment; (2) the investigation level above which the supervisor of the monitored worker considers the need for an investigation of the cause of the exposure. A third level, the reporting level, should be added at which the interpreted result has to be reported to the relevant government inspectorate or senior management of the employing organization. (UK)

56490 EVALUATION OF DOSE COMMITMENT FOR INDUSTRIAL TRITIUM WORKERS. Jones, D. E. A. (Brandhurst Co. Ltd., High Wycombe, Eng.). Brit. J. Radiol.; 45: No. 537, 708-9(Sep 1972).

A simple graphical method is presented for evaluating dose commitments (in mrem) from results of urine sampling for tritium. The sampling interval was 14 days. It is suggested that a knowledge of the trend of unreported levels could be an indication of a slow and otherwise undetected deterioration in working environments where the reporting level is only rarely succeeded. The ICRP term, "investigation level" is criticised, "reporting level" being suggested instead. It is pointed out that "trivial" might be more apt than the ICRP term "negligible" level. (UK)

56491 EFFECT ON PRE-IMPLANTATION DEATH OF FEEDING RATS ON RADIATION-STERILIZED FOOD. Eriksen, W. H.; Emborg, C. (Danish Atomic Energy Commission, Risoe). Int. J. Radiat. Biol.; 22: No. 2, 131-5(Aug 1972).

Three groups of SPF Wistar rats were fed on radiation-sterilized, (5 Mrads in a 10 MeV linear electron accelerator), autoclave-sterilized, and ordinarily autoclave-treated SPF food, respectively. All females were autopsied 15 to 17 days after the mid-week of presumptive mating. Corpora lutea, deciduomata, dead, and living embryos were counted. The induction of dominant lethal mutations was evaluated by comparing the ratio of living embryos with the number of corpora lutea in the three groups. No indication of dominant lethal mutations being induced in the group fed on radiation-sterilized feed was found. (auth)

56492 CALCULATIONS OF WHOLE BODY DOSE FROM ABSORPTION OF AN INHALED NOBLE GAS. Whitton, J. T. (Central Electricity Generating Board, Berkeley, Eng.). Health Phys.; 23: No. 4, 573-5(Oct 1972).

A method of calculating the contribution to the whole body dose from the inhaled gases is described, depending on the tissue/blood partition coefficient of each organ. The partition coefficient is defind as "the ratio of the equilibrium concentration of the inert gas in the liquid to its concentration in the gas", both concentrations being expressed in terms of an amount/unit volume. Corrections are made to take into account three body types (lean, fat, and normal). Krypton-85 and ^{133}Xe were used as illustrations. For a short term exposure of 1 min and a long term exposure of several hours to a cloud of ^{85}Kr, the dose to most body tissues arising from absorption of the inhaled gas represented about 1% of the dose received from irradiation by the gammas and bremsstrahlung external to the body. The corresponding fraction for the fatty tissues was 10% due to the increased solubility of the inert gases. The use of this fact in assessment of total body fat is pointed out. (UK)

56493 NATURAL URANIUM IN MAN. Malenchenko, A. F.; Shchekina, G. D.; Seregin, V. V. (Inst. of Nuclear Energy, Minsk). Dokl. Akad. Nauk BSSR; 16: No. 1, 87-9(Jan 1972). (In Russian).

The content of natural uranium in the organs and tissues of man was investigated. The greatest concentrations were found in the skin, suprarenal glands, thyroid gland, kidneys, and spleen. The smallest concentrations were located in the heart, stomach, and uterus. The total U content in the organism was 3.06×10^{-4} g. An analysis of U contents in organs and tissues was made in relation to sex and age. (tr-auth)

56494 ROLE OF MEASUREMENTS ON PHANTOMS AND HUMAN SUBJECTS IN BODY-BURDEN EVALUATION. Gongora, G.; Gongora, R.; Jammet, H. (Institut due Radium, Paris). pp 27-43 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB-290; CONF-711104.

The evaluation of human body burdens of radioisotopes gives rise to problems associated with the energy of the radioisotopes, their localization, or redistribution, and individual morphology. Studies on phantoms and the data obtained from clinical examinations determine the choice of the measurement method and of the standard, the choice being a function of the problem at issue, which is defined mainly by the activity level, energy of the radioisotope, need or otherwise to obtain topographic data, and type of localization or redistribution if known. The phantoms used are mostly solid lamellar ones of IAEA type, liquid phantoms with anatomical segments, and also organ phantoms. Furthermore, simple phantoms based on individual characteristics have been constructed for particular conditions. The clinical data have been obtained from examinations carried out with radioisotopes having various distributions, which were mainly diffuse, in bone, liver, and lung. The conclusions relate to the indications of the measurement method, whether static or dynamic, and to the use of different types of phantoms for calibration purposes. (auth)

56495 PROPOSED SELECTION CRITERIA FOR MONITORING THE INCORPORATION OF RADIOACTIVE SUBSTANCES IN OCCUPATIONALLY EXPOSED PERSONS. Schmier, H.; Kistner, G. (Federal Health Office, Berlin). pp 59-64 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB-290; CONF-711104.

Criteria are presented that have been used in the Federal Republic of Germany since 1967 for monitoring the incorporation of radioactive substances in occupationally exposed persons. The criteria are based on the mean activities of unsealed radioactive substances handled at the place of work, and on the ways in which they are used. The activity limit which, when exceeded, requires routine monitoring of the incorporation, will normally be a thousand times the MPBB specified in publication 2 of the ICRP. The results of monitoring radioactive incorporation in personnel in the Federal Republic of Germany are reported for the last few years. (auth)

56496 AUTOMATIC DETERMINATION OF TRITIUM IN URINE BY LIQUID SCINTILLATION. Gillet, R.; Recibeau, A.

(Univ. Catholique de Louvain, Heverlee, Belg.). pp 255-65 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The problems raised by the determination of tritium body burdens of personnel by measuring urine activities are now solved satisfactorily by the liquid scintillation technique. This technique is simple to use, and the counting efficiencies are excellent at temperatures close to ambient. The major problem remaining to be solved is to ensure a rapid and, if possible, automatic conversion of the counting results into actual activity. The phenomenon of counting rate quenching is particularly important in the case of biological samples, since it leads to very appreciably efficiency variations from sample to sample. The authors have made efforts to find the best practical conditions for counting in emulsions and to apply the technique of standardization by an external source to the determination of efficiencies. Of the three factors contributing to quenching in urine, water, mineral burden, and color, the authors have experimentally shown that the sample's color alone is responsible for the variability of this phenomenon. Efficiency variations have been studied as a function of quenching in more than 60 urine samples. The results make it possible to plot a calibration curve giving the counting efficiency as a function of the ratio of the external channels. The regression coefficients of this curve are next introduced in the form of a program into a PDP 9 digital computer. The crude results obtained on punched tape from an automatic sample changer with a capacity of 420 samples are then processed by the computer, which gives direct readings of tritium activities in urine. (auth)

56497 RADIATION DOSE IN DIFFERENT ORGANS OF THOROTRAST PATIENTS. Muth, H. (Univ. Saarlandes, Homburg, Ger.); Edelmann, L.; Grillmaier, R.; (and others). pp 457-67 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The paper reports the results of biophysical examinations of about 200 Thorotrast patients. Measurements were made of the effective total-body radioactivity with a whole-body counter and of the thoron concentration in the exhaled air. In addition, extensive animal experiments with rabbits were made to study the dependence upon time of the activity ratios of ^{232}Th and its decay products, their distribution in the organs of the reticulo-endothelial-system and in the marrow-free bone respectively, and to study their elimination. As the physical properties of the Thorotrast suspension at the time of injection greatly influenced the radiation dose rate, it was necessary to study segregation of the thorium decay products in the colloidal suspension. Taking into account the experimental animal data and using the results of the direct measurements on the patients, it was possible to calculate both the dose rate as a function of the age of the Thorotrast burden and the accumulated radiation dose in different organs of the patient (liver, spleen, marrow-free bone, bone marrow, and lungs). The average values as well as the lower and upper limits of the radiation exposure of the different organs are given. These data are important when considering the possible incidence of late radiation effects, such as leukemia, carcinoma of the liver, lung cancer, and bone tumors in Thorotrast patients. (auth)

56498 RETENTION AND EXCRETION EQUATIONS FOR DIFFERENT PATTERNS OF UPTAKE. Butler, G. C. (National Research Council of Canada, Ottawa). pp 495-508 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The general relations between uptake, retention, and excretion of a radionuclide as functions of time are given. These are used to derive retention and excretion equations for the following patterns of uptake: single isolated; chronic; irregularly repeated; and continued but declining. These will be applied to calculations of the body content and excretion of some of the radionuclides most commonly encountered in radiation protection. The differences between the bone-seeking radionuclides and the others will be noted. Investigation levels and derived investigation levels (ICRP Publication 10) are defined and the retention and excretion equations used to calculate them. The method of calculating radiation doses to organs and tissues is also described. (auth)

56499 DEVELOPMENT OF AN EXTENDED FORMALISM FOR INTERNAL DOSE CALCULATION AND FOR PRACTICAL APPLICATION TO SEVERAL BIOLOGICALLY DISTRIBUTED RADIOELEMENTS. Roedler, H. D.; Kaul, A.; Berner, W.; Koeppe, P.; Glaubitt, D. (Freie Univ., Berlin). pp 515-41 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The Medical Internal Radiation Dose (MIRD) Committee has developed a method for absorbed-dose calculation for biologically distributed radioelements for specified pairs of source and targe organs. This method was extended to the estimation of the additional target dose resulting from the radioactivity distributed within the remaining parts of the body. As a first approximation the radioactivity which is not located in the source organs examined was assumed to be distributed within the whole body and to be excreted with the effective half-life for the total body. As a second approximation the half-life for the total body was replace by that for the rest of the body which was calculated for the distribution factors and half-lives of the source organs and the total body. As a third approximation, which is the formally exact solution, the error arising from the uniform distribution of the remai ing radioactivity within the total body is compensated by means of a correction term. The absorbed doses resulting from the firs two approximations are compared with those calculated by the las one. Moreover, absorbed doses according to the effective radius method were compared with those having been calculated by mear of the absorbed fraction method as well as by the formally exact solution of the extended MIRD schema. This extended schema wa applied to absorbed dose estimations for radioelements whose biological data were determined by our animal experiments or from data published by others. The following radioelements were used: ^{57}Co, ^{65}Zn, ^{67}Ga, ^{131}I, and ^{203}Hg. Moreover, in the case of ^{57}Co, ^{65}Zn, and ^{203}Hg the dose reduction was determined by applying dimethylcysteine as a chelating agent. The dose calculations especially refer to the gonads as target organs as well as to the different critical organs. (auth)

56500 DOSE TO MAN FROM ATMOSPHERIC ^{85}Kr. Diethorn W. S.; Stockho, W. L. (Pennsylvania State Univ., University Park). Health Phys.; 23: No. 5, 653-62(Nov 1972).

The contribution of atmospheric ^{85}Kr to man's radiation dose burden is reexamined. Earlier work is updated and the major dimensions of the problem discussed. Today, the dose ranges from a bare skin dose of approximately 10^{-3} mrad/yr to a whole-body dose of approximately 10^{-4} mrad/year. The skin dose is comparable to the whole-body dose from natural ^{3}H. If the world-wide practice of dumping ^{85}Kr into the atmosphere is not curtailed, these doses will increase by a factor of 30 in the next decade or two. (auth)

56501 STUDIES OF THE ELIMINATION RATE AND THE RADIATION EXPOSURE FOLLOWING INGESTION OF ^{222}Rn RICH WATER. Suomela, M.; Kahlos, H. (Inst. of Radiation Physics, Helsinki). Health Phys.; 23: No. 5, 641-52(Nov 1972).

Radon-222 and its daughters in drinking water cause a radiation dose to the stomach of the order of Maximum Permissible Dose if water containing 100 nCi^{222}Rn/l is consumed regularly. To evaluate the radiation dose in real conditions two types of experiments were performed with a whole-body counter. In the first series of measurements the elimination of ^{214}Bi from the body was followed in test subjects who had ingested radon-rich water in a single intake. A one-component exponential function with a biological half-life varying from 30 to 50 min was found to describe the elimination of radon. Special attention was paid to the escape of radon from the water and its effect on the state of disequilibrium between radon and its daughters after intake. In the second series of measurements a group of persons who had consumed radon-rich water daily was studied. The daily radon intake of these persons was estimated at 60 nCi, obtained in two or three portions. From the results of the experiments the dose equivalent of 240 to 440 mrem/μCi^{222}Rn was derived and the maximum daily intake was set at 0.1 μCi for ^{222}Rn in drinking water. (auth)

Animals

Refer also to abstracts 56549, 56553, and 56560.

56502 (CONF-701067) AIR POLLUTION MEDICAL RESEARCH CONFERENCE, OCTOBER 5–7, 1970, NEW ORLEANS. (American Medical Association, Chicago, Ill. Dept. of Environmental Health). 1970. 348p.

Separate abstracts were prepared for two papers presented at the conference. Various aspects of air pollution are discussed in an additional nineteen papers. (H.L.W.)

56503 (CONF-701067—, Paper 15) CHRONIC EFFECTS OF THE INHALATION OF INSOLUBLE URANIUM COMPOUNDS IN

ANIMALS. Hodge, Harold C.; Leach, Leonard J.; Yuile, Charles L.; Maynard, Elliott, A.; Wilson, Herbert B.; Sylvester, George E. (Univ. of Rochester, N. Y.). 1970. 15p.

From Air pollution medical research conference; New Orleans, LA. (5 Oct 1970).

Results of short-term studies with guinea pigs, rabbits, and rats showed that inhalation of UO_2 dust produced renal changes and weight loss only when the atmosphere contained more than 22 mg UO_2/m^3. One-year studies on dogs, monkeys, guinea pigs, and rabbits exposed to uranium compounds showed slight renal changes. Pathological effects on lungs, blood, and tracheobronchial lymph nodes are also reported. A five-year inhalation study was conducted on the effects of inhalation of UO_2 dust on body weight, blood, and tissues of monkeys, dogs, and rats. A six-year post-exposure study was carried out on dogs and monkeys; emphasis was placed on delayed effects and fate of deposited uranium in tissues, especially in the lungs and tracheobronchial lymph nodes. The uranium content of respiratory tract structures of dogs and uranium workers was measured by scintillation spectroscopy using 186 keV gamma rays from ^{235}U. Histological examinations of animals sacrificed at one-year intervals during the six-year post-exposure period are described and results of studies on estimation of lung burdens from urinary excretion data are discussed. (H.L.W.)

56504 (RLO-2213-1(Suppl.1)) ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION. A Selected Bibliography. Schultz, Vincent (Washington State Univ., Pullman. Dept. of Zoology). Sep 1972. 129p. Dep. NTIS.

A revision of the original bibliography published in 1969 is presented. Over fourteen hundred references on the use of radioisotopes and radiation in ecological studies on insects, fish, other animals, and plants are included. (H.L.W.)

56505 FUNCTIONAL AND MORPHOLOGICAL INVESTIGATIONS OF THE LIVER OF RABBITS TREATED WITH SMALL DOSES OF URANYLNITRATE AND SULFATIZED APRICOTS. Markova, M.; Bashev, Z.; Zlateva, M. Khig. Zdraveopazvane: 14: No. 4, 386-97(1971).

The clinical, biochemical and pathomorphological studies on the liver of rabbits treated with uranyl nitrate revealed the existence of cirrhotic alterations typical for an uranium intoxication. It is considered that a great increase of bilirubin and its fractions, as well as a positive Weltmann test are an early sign in uranium damage. Feeding with sulfatized apricots in combination with uranyl nitrate has no effect on the alterations, i.e. the apricots have no protection effect in uranium intoxication. Even feeding only with sulfatized apricots without uranyl nitrate causes liver lesions, due probably to the action of sulfurous anhydride. In contrast to that, feeding only with frozen apricots produces no pathologic alterations. (Abstr. Bulg. Sci. Med. Lit.)

56506 RADIATION DOSE TO THE GASTROINTESTINAL TRACT OF FARM ANIMALS AFTER INGESTION OF A FALL-OUT SIMULANT. Wade, L. Jr.; Sasser, L. B.; Bell, M. C. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Health Phys.; 23: No. 4, 469-74(Oct 1972).

Radiophotoluminescent glass dosimeters were used to measure the radiation dose to the gastrointestinal tract of sheep, cattle, and swine after ingestion of a ^{90}Y-tagged fallout simulant. Measured doses were compared with dose calculations based on models developed for ruminants and simple-stomached animals. The measured doses compared favorably with the calculated doses for the large intestine, but were an order of magnitude greater than calculated doses for the stomach of swine and for the abomasum and rumen of sheep and cattle. It was suggested these discrepancies are due primarily to the differences in size and density between the radioactive sand particles and other gastrointestinal contents. (auth)

Plants

Refer also to abstract 56386.

Nuclide Kinetics and Toxicology

Refer also to abstracts 56487 and 56488.

56507 BIO-ASSAY RESULTS OF A CASE OF PLUTONIUM INHALATION. Alderhout, J. (Eurochemic, Mol, Belg.). pp 635-40 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB-290; CONF-711104.

The bio-assay results for a man involved in at least two incidents leading to inhalation of an isotopic mixture of plutonium nitrate are reported and discussed. Plutonium urinary excretion was followed, some fecal analyses were carried out, and one direct determination with a lung counter was made. From the results of these examinations an internal contamination of the order of one maximum permissible body burden of plutonium alpha-activity was concluded. In addition, about half a maximum permissible body burden of ^{241}Am might still be formed from ^{241}Pu decay. Months after the accidental intake two single doses of DTPA were administered at an interval of several months, one intravenously and one by means of inhalation. After each treatment the alpha activity of the plutonium in the urine rose considerably and remained high for a long time. Some additional data are reviewed for a case of plutonium inhalation already reported elsewhere. (auth)

Man

Refer also to abstracts 55740, 56185, and 56410.

56508 (NIRS-Pu-7, pp 31-4) PLUTONIUM LUNG MONITOR USING A THIN NaI (Tl) CRYSTAL OF LARGE AREA. Ishihara, Tomio; Nohara, Norimasa; Iinuma, Takeshi; Tanaka, Eiichi; Yashiro, Shigeo (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

For the assessment of plutonium amount in human lungs, a very efficient detector for low energy photons is necessary because of the low energy of emitted x rays (17 keV on the average) and the small value of maximum permissible lung burden of ^{239}Pu, 16nCi. As such a detector, a combination of an 8 in. diameter by 2 mm thick NaI (Tl) crystal and a 7 in. diameter photomultiplier was used in order to cover a large portion of the human lungs. The detector was set in a shielding chamber of 20 cm thick iron plus 3 mm thick lead that is being used for the whole body monitor. Extraction of the optimum performance from the detector was attempted by determination of an optimum thickness of the light guide (made of Lucite) and noise rejection with pulse shape discrimination technique. Counting efficiency for ^{239}Pu in the lungs was determined with a phantom No. 3 (realistic phantom of the human thorax). The detector was placed in a similar geometry to that in the measurement of actual human subjects. The counting efficiency was found to be 2.85×10^{-3} cps/nCi of ^{239}Pu. The minimum detectable amount defined as 3 times the standard deviation of background counts is 12.6 nCi of ^{239}Pu for a counting time of 100 min. The background counts include those from degraded γ rays of ^{137}Cs and K in a normal subject. (auth)

56509 (STI/PUB-290) ASSESSMENT OF RADIOACTIVE CONTAMINATION IN MAN. Proceedings Series. Proceedings of a Symposium on Assessment of Radioactive Organ and Body Burdens, Held in Stockholm, 22-26 November 1971. (International Atomic Energy Agency, Vienna (Austria)). May 1972. 706p. (In French and English). (CONF-711104). IAEA $21.00.

Separate abstracts were prepared on 40 papers presented at this symposium. Abstracts of four papers appeared in NSA previously. (C.H.)

For abstracts of individual papers see: 55768, 56058, 56059, 56199-56205, 56494-56499, 56507, 56520-56539, and 56561-56563.

56510 (TID-26175) OCCURRENCE OF ^{137}Cs IN THE BIOSPHERE EVALUATED WITH ENVIRONMENTAL AND METABOLIC STUDIES. Haesaenen, Erkki (Helsinki Univ. (Finland). Dept. of Radiochemistry). Feb 1972. 40p. Dep. NTIS.

The fallout studies carried out in the Department of Radiochemistry, Helsinki University (Finland) are reviewed. Its main emphasis has been on the γ spectrometric determination of the ^{137}Cs-levels and changes herein in different environmental samples and in man after the second nuclear testing period in 1961 and 1962. Special attention has been paid to the aquatic foodchains of ^{137}Cs, to the reindeer-lichen-man foodchain, and to the biological half-life of ^{137}Cs in man and in certain fish species. (auth) (Finland)

56511 UPTAKE OF ^{67}Ga IN COLONIC AND RECTAL TUMOURS. Nash, A. G.; Dance, D. R.; McCready, V. R.; Griffiths, J. D. (Royal Marsden Hospital, London). Brit. Med. J.; 3: No. 5825, 508-10(26 Aug 1972).

The uptake of ^{67}Ga in biopsy specimens of normal and abnormal tissue was measured in 20 cases of colonic and rectal disease and the ratio between the ^{67}Ga uptake in these diseases and in the normal colon or rectum was determined. Uptake of the isotope was high in most of the 14 primary malignant tumors, being highest in poorly differentiated tumors. This uptake was found to be concentrated at the active tumor edge. Uptake of the isotope was generally low in nonmalignant lesions. (auth)

56512 RETENTION OF RADIOACTIVE LABELED AEROSOL PARTICLES OF DIFFERENT KINDS IN THE HUMAN RESPIRATORY TRACT. Reiter, R.; Carnuth, W.; Poetzl, K. Atomkernenergie; 20: No. 1, 79-88(1972). (In German).

Total particle deposition in the human respiratory tract was determined on human subjects (seated quietly), within a diameter range from 0.08 μm up to 4 μm (aerodynamic diameter). The following test aerosols were used: natural aerosol in an abandoned mine gallery, ZnO smoke, as well as fine particles of ZnO and MgO produced by means of a flame-type aerosol generator. The following equipment and principles were used in measuring particle size distribution: Goetz aerosol spectrometer (measurement of particles (i) by trapped radon decay products, and (ii) by chemical mass determination), cascade impactor (particle measurement as (i) and (ii) above), Royco counter with subsequently added multichannel analyzer. Evaluation of the measured data is preponderantly performed by computer. It was revealed that in the range of an aerodynamic diameter from 4 μm to 0.08 μm, the probability of deposition will drop from 78 to 11%, and no reincrease is apparent as a result of diffusion deposition increasingly taking effect down to 0.08 μm. The results of the measurements are compared with data from other scientific publications. The studies will be continued with particles in the diameter range of 0.01 to 0.1. (auth)

56513 CONTAMINATIVE BEHAVIOR OF PLUTONIUM CHLORIDE ON PROTEIN FILM. Tashiro, Shingo (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 9: No. 6, 344-7(Jun 1972).

The contaminative behavior of plutonium chloride on a protein film was studied in order to contribute to the knowledge of actual skin contamination. The experiments were carried out by changing such factors as soiling time, radioactive concentration, the concentration of coexisting electrolyte, acidity of the soiling solution, and washing time. It was found that the contamination of plutonium varied with soiling time and with the acidity of the soiling solution. Maximum contamination was observed at pH 0.9. The mechanism of contamination is discussed, and it is concluded that contamination would appear to be promoted by the formation of aggregated plutonium produced by the interaction with the surface of the protein film. (auth)

56514 AGE DEPENDENCY OF THE DOSE FACTOR FOR INGESTION OF ^{131}I. Bayer, A. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech.; 17: No. 8, 417-19 (Aug 1972). (In German).

Atmospheric ^{131}I can be incorporated either by inhalation or ingestion. Ingestion occurs mostly through milk products. For these, the age-dependent dose factor is calculated. Results, represented in tables and graphs, show that the factor is strongly age-dependent. The ratio between a one-year old child and an adult is 30 : 1. (H.B.G.)

56515 IN VIVO MEASURED EFFECTIVE HALF-LIFE OF ^{125}I IN HUMAN THYROIDS. Bordell, F. L.; Sayeg, J. A.; Wald, N.; Wechsler, R. L. (Univ. of Pittsburgh). Phys. Med. Biol.; 17: No. 3, 365-73(May 1972).

Seven radiation workers accidentally inhaled ^{125}I vapors released from an open beaker. Thyroidal uptake was found by scintillation counting methods with both collimated and uncollimated NaI(Tl) crystal detectors. Retention studies were performed on five of the individuals. Exponential retention patterns were observed for thyroidal ^{125}I activity. Effective half-lives ranged from 38 to 45 days, the average being 41 ± 2 days. Total dose values for the individual uptakes, computed by extrapolation of the retention data back to zero time, ranged between 1.1 and 109 rads. The in vivo measurements, medical management, and internal dosimetry calculations are described. (auth)

56516 PREDICTION OF FUTURE AND RADIOACTIVE BURDEN OF HUMAN BODY TO THE ^{90}Sr AND ^{137}Cs IN SLOVAKIA. Csupka, S. (Oblastna Hygienicka Stanica, Bratislava). Bratislav. Lek. Listy; 57: No. 3, 271-81(Mar 1972). (In Czech).

The daily intake of ^{90}Sr and ^{137}Cs in foodstuffs was taken as the basis of the radioactive burden of the population. Since the concentration of radionuclides in the foodstuffs is dependent on their height in the radioactive fallout, the estimate was carried out on the basis of the yearly deposit of radionuclides in the year 1969 according to two assumed models; that is as a constant and as a decreasing yearly fallout. The yearly deposit in 1969 can be expressed as follows: 1 nCi ^{90}Sr/m^2 and 1.9 nCi ^{137}Cs/m^2. In calculating the intake of ^{90}Sr and ^{137}Cs with foodstuffs, there was taken into account a constant of (500 g daily) and an increasing (1 kg daily in the year 2000) consumption of milk and milk products. From the daily intake of radiostrontium and radiocesium in the diet, the concentration was estimated as ^{90}Sr in human bones and the burden of the human organism as ^{137}Cs up to the year 2000. The ratio of ^{90}Sr to 1 g of calcium in the milk/diet moves within the limits of 0.7 to 1.0 and in the human bone/diet up to the age of 4 yrs, 0.35 and above 4 yrs, 0.25. For estimating the burden of the human organism with ^{137}Cs, 10 nCi was taken as the basic value in the year 1969. (auth)

56517 THORIUM DAUGHTERS IN THE SPLEEN OF A THOROTRAST CASE. Lucas, H. F. Jr. (Argonne National Lab., Ill.); Markun, F.; May, H.; MacDonald, N. S.; Sweeney, J. Health Phys.; 23: No. 4, 575-6(Oct 1972).

The removal of a human spleen from a Thorotrast patient was used in an attempt to establish the ratios of the ^{232}Th daughter products to their parent for species with half-lives greater than 1 hr. The following activity ratios are tabulated in a brief note:- ^{228}Ra/^{232}Th, ^{228}Ac/^{228}Ra, ^{228}Th/^{228}Ra, ^{224}Ra/^{228}Th, ^{212}Pb/^{224}Ra, ^{212}B ^{212}Pb. The amounts of ^{228}Ac, ^{224}Ra, ^{212}Bi, at the time of surgery were obtained from the growth curves of ^{228}Ac and ^{212}Bi measure at UCLA over a 36-day period; since calibrated spectra were not available, the change in counting rate with time after surgery of ^{208}Tl(2.3 to 3.0 MeV) and of ^{228}Ac(0.8 to 1.2 MeV) were used. All ratio values obtained were in good agreement with previous literature, except for ^{212}Bi, for which there were no other human data available. The ^{212}Bi was approximately twice the 0.66 found in rats, rabbits, and dogs. (auth)

56518 ^{60}Co A CONSTANT CONTAMINANT OF PHARMACEUTICALLY PREPARED ^{59}Fe. LeBlanc, A. D.; Johnson, P. C. (Baylor Univ., Houston, Tex.). Phys. Med. Biol.; 17: No. 3, 418-19(May 1972).

Tabulated results are presented for the ratio of ^{60}Co to ^{59}Fe activity found in six ^{59}Fe commercial preparations prepared for human use. Ratios varied from 1/1270 to 1/2000. It is concluded that levels of ^{60}Co found would be considered minimal but only on the assumption that the solution would be used near the assay date. (UK)

56519 HEAVY WATER ENHANCES IgE-MEDIATED HISTAMINE RELEASE FROM HUMAN LEUKOCYTES: EVIDENCE FO MICROTUBULE INVOLVEMENT. Gillespie, Elizabeth; Lichtenstein, Lawrence M. (Good Samaritan Hospital, Baltimore). Pro Soc. Exp. Biol. Med.; 140: No. 4, 1228-30(Sep 1972).

Deuterium oxide, an agent known to stabilize microtubules, greatly enhances antigen-induced histamine release from human leukocytes. Concentrations as low as 7% are effective and enhancement occurs over a wide range of antigen concentrations. The effects of D$_2$O are partially reversed by colchicine, a drug known to disrupt microtubules. These findings strengthen the view that microtubules are involved in the secretory mechanism by which the mediators of the allergic response leave the IgE containing target cells. (auth)

56520 INHALATION OF INSOLUBLE IRON-OXIDE PARTICLES IN THE SUBMICRON RANGE. Ramsden, D.; Waite, D. A. (Atomic Energy Establishment, Winfrith, Eng.). pp 65-81 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Recent studies have been concerned with the production of aerosols of insoluble ferric oxide in the size range 0.08 to 0.5 micron using an ultrasonic nebulizer. The tagging of these particles with radioactive labels, the inhalation of such aerosols under controll conditions, the detection and distribution of the material in vivo, together with studies of excretion from the body are discussed. Two groups of inhalations were studied: chromium-51-labeled aerosols and plutonium-237-labeled aerosols. Lung retentions ar excretion curves for man were obtained for aerosols labeled with ^{51}Cr (0.1 microns count median diameter). Two forms of chromium label, termed leachable and non-leachable, were used. The combination of in-vitro leaching studies and urine and feces anal sis enabled both sets of inhalation data to be normalized to give t retention of the iron-oxide particles in the lung. Long-term rete tion of 80% of the initially deposited aerosol with deep-lung location and half periods of clearance of the order of 270 days were found using whole-body counting. In the context of this paper ^{237}P was considered as a simulator for ^{239}Pu because of the close mat of their low-energy x-ray emissions. Two types of breathing pattern were used giving lung retentions of 90% and 5% with deposit in the pulmonary region and upper respiratory tract respectively The lung-retention curves and excretion patterns for man are presented and the extrapolation to the cases of inhalation of ^{239}Pu considered. The results are compared with predictions made fr realistic chest phantoms calibrated for ^{239}Pu. (auth)

56521 FACTORS AFFECTING THE ASSESSMENT OF ^{239}Pu IN VIVO BY EXTERNAL COUNTING METHODS. Newton, D.; Fry, Frances A.; Taylor, B. T.; Eagle, M. C. (Atomic Energy Research Establishment, Harwell, Eng.). pp 83-96 of Assessment of Radioactive Contamination in Man. Vienna; Internationa Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

In estimating lung burdens of ^{239}Pu by external counting of its low-energy x rays, it is necessary to allow for their attenuation in the chest wall and for the variability of this factor in subjects of different sizes. This has been studied using the 20-keV x rays from ^{103}Pd, incorporated in an aerosol of 5-μm polystyrene particles which were inhaled by volunteer human subjects covering a range of weights and heights. The aerosol was also labeled with ^{51}Cr (323-keV gamma rays) so that the retention of the particles, and hence the ^{103}Pd present in each subject's lungs, could be determined by external scintillation counters. This technique was previously used to demonstrate a strong correlation between x ray attenuation, as measured using a large-area (30 cm × 30 cm) argon-filled proportional counter mounted over the chest of a supine subject, and crude measures of his body build, such as chest circumference; this provided a basis for predicting calibration factors when subjects with suspected ^{239}Pu contamination were examined. The present experiments were conducted primarily in order to establish these relationships more firmly and to evaluate other detectors and measurement geometries, including an alternative arrangement of two smaller proportional counters (15 cm × 30 cm) positioned one over each lung. Measurements were made at intervals for several weeks after inhalation. After the partial rapid clearance of the particles during the first few days, counting efficiencies for individual subjects were essentially constant. It appears that with either system of proportional counters the limit of detection for ^{239}Pu in the lungs of a small subject (chest circumference 90 cm) is in the region of 4 nCi, increasing in larger individuals by about a factor of two for each additional 10-cm circumference. The influence of the subject's respiratory pattern during administration of the aerosol was studied; this had no demonstrable effect on detection efficiency with the proportional-counter systems, although efficiencies substantially higher than expected were found in the only two subjects who smoked habitually. On the other hand, in certain restricted regions of the chest viewed by collimated scintillation counters, the x ray transmission appeared to be enhanced by about a factor of two, in cases where deep breathing of the aerosol had been substituted for more normal respiration. Some observations on the influence of the subject's posture during measurement, and on the relative transmission of the x rays through the front, back, and sides of the thorax are also reported. (auth)

56522 DIRECT METHODS FOR THE ASSESSMENT OF ^{239}Pu AND ^{235}U BODY BURDENS. Morsy, S. M.; El-Assaly, F. M.; Aloush, A. A. (Atomic Energy Establishment, Cairo). Contract 827/RB. pp 115-27 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Methods for the assessment of ^{239}Pu and ^{235}U body burdens are described. The assessment of ^{239}Pu is based on the detection of the L x rays of ^{235}U resulting from α-decay of ^{239}Pu and the assessment of ^{235}U is based on the detection of the 186-keVγ ray resulting from the de-excitation of ^{231}Th produced from the α-decay of ^{235}U. To determine the activity of ^{239}Pu and ^{235}U quantitatively, the depths at which these elements occur in the body have to be estimated because of the high attenuation coefficients of the emitted photons in the tissue. Depth evaluation is based on the correlation of the changes in the energies of the emitted photons with the depth of the tissue under which the activity is localized. These changes in photon energy are reflected in: a photopeak shift resulting from the increase in intensity of Compton-scattered radiation due to the interaction of the emitted photons with the tissue-equivalent material (a linear relation up to 6 cm thickness is found for ^{235}U and up to 4 cm for ^{239}Pu); a spread in the photopeak, reflected in its energy resolution, resulting from the scattering of the emitted photons in the tissue-equivalent material (a linear relation up to 10 cm depth was found for ^{235}U and a linear relation with a negative slope was found from 2 to 6 cm depth for ^{239}Pu); and a third factor taken into consideration for depth evaluation of ^{235}U was the relative intensities of the 186-keV band (i.e., 154 to 220 keV) and the adjacent (114 to 154 keV) band (a linear relation was found between depths of 1 cm and 8 cm). The assessment of ^{239}Pu was carried out with two NaI(Tl) detectors 10.16 cm in diameter and 4 mm thick positioned on a human phantom. A minimum detectable activity of 12 nCi was obtained at a depth of 6 cm of tissue (MPBB 16 nCi). For the assessment of ^{235}U, a NaI(Tl) crystal 20.32 cm in diameter and 10.16 cm thick was used. A minimum detectable activity of less than 1 nCi was obtained at a depth of 6 cm of tissue (MPBB 10 nCi). In all cases, the errors in estimating peak-shift and resolution were reflected back on the determined activity. (auth)

56523 IN-VIVO MEASUREMENTS OF ^{210}Pb IN MAN. Wrenn, McD. E. (New York Univ., N. Y.); Cohen, N.; Rosen, J. C.; Eisenbud, M.; Blanchard, R. L. pp 129-46 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

A dual thin-crystal detector operated in anti-coincidence with a thin-windowed proportional chamber has been developed for high-efficiency very low-background measurements of low-energy photon emitters in man. This instrument has been applied to the measurement of ^{210}Pb in uranium miners who, as a consequence of chronic inhalation exposure to uranium mine atmospheres, accumulate ^{210}Pb in their skeletons. The highest skeletal burden measured in miners from the Colorado plateau has been 80 nCi, two to three orders of magnitude above normal ^{210}Pb burdens in man. About 30 highly exposed miners have been measured and the skeletal content of ^{210}Pb estimated from calibrations performed with skull phantoms. Correlations of skeletal ^{210}Pb with urinary output and ^{210}Pb content of blood samples have been made. Sequential measurements of several adult retired miners over a period of three years indicate that the rate of elimination of lead may average about five years. The development of this sensitive instrumental technique may make it possible to assess the magnitude of prior exposure of uranium miners to mine atmospheres, where measurements of mine atmospheres were not made. The detection limit of the instrument is about 300 pCi of ^{210}Pb in the skull, or roughly equivalent to 200 working-level months. (auth)

56524 PROBLEMS OF USING URINARY EXCRETION DATA FOR EVALUATING BODY BURDEN. Lafuma, J.; Nenot, J. C.; Morin, M. (CEN, Fontenay-aux-Roses, France). pp 235-45 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The methods of evaluating bone burden after contamination by a transuranic element are based on the hypothesis that urinary clearance reflects the bone burden through the fraction released daily by the bone. Various mathematical methods are used for this purpose and the reference coefficients are, in general, derived from data obtained after intravenous injection of plutonium-239 citrate into human subjects. In fact, diffusion in the organism is very slow, and while some of the amount which diffuses is fixed in the skeleton, the rest is eliminated by the urine. Daily urinary elimination therefore reflects the diffusibility of the element, which depends on the manner of contamination and on the physico-chemical forms involved. On the other hand, secondary distribution in the organs is relatively constant, and a constant relationship exists between the fractions fixed by the liver and skeleton and the cumulative urinary excretion, which can thus be used for determining body burdens. (auth)

56525 MEASUREMENT OF ^{210}Pb (Ra—D) IN THE URINE OF PERSONS WITH RADIUM BURDENS AND ASSESSMENT OF ITS LONG-TERM EXCRETION RATE FOR ^{210}Pb. Khandekar, R. N.; Weyers, C.; Dulcino, J.; Koch, G. F. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 247-54 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

An analytical procedure was developed for the estimation of extremely low activities of ^{210}Pb in urine samples. Lead is radiochemically separated from urine samples and counted in a low-background beta counting set-up, using 1.17-MeV betas of its daughter ^{210}Bi, both to estimate the activity of ^{210}Pb and to check the radiochemical purity of the samples analyzed. A number of urine samples of normal individuals are analyzed to estimate the background of ^{210}Pb in the urine. The urine samples of persons who have been contaminated with ^{226}Ra at different times are also analyzed for ^{210}Pb. The ^{210}Pb body burden is estimated from the measured body burden of ^{226}Ra, and the excretion coefficient values for ^{210}Pb are calculated. (auth)

56526 RADIOACTIVE AND STABLE CESIUM IN THE BODIES OF CHILDREN AND TEENAGERS IN POLAND IN 1967. Pietrzak-Flis, Zofia; Bysiek, Maria (Central Lab. for Radiological Protection, Warsaw). pp 283-9 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The contents of ^{137}Cs and of stable Cs were determined in the diet, urine, and feces of a group of 6- to 7-year old children living at the Orphan Home in Warsaw as well as in the diet of 17- to 19-

year-old teenagers living at the Boarding School of Gardening at Sochaczew near Warsaw. The body burden of ^{137}Cs in ten randomly chosen teenagers was measured by the whole-body counter. The ^{137}Cs content in the collected samples was determined by measuring the radioactivity of a thin AMP layer through which an acidified solution of the ashed samples had been filtered. The stable Cs content was determined on this same AMP layer by thermal neutron activation analysis. The contents of ^{137}Cs and of stable Cs in the body of the children were calculated from the excreta, using the biological half-life value from the empirical equation given by McCraw. The mean content of ^{137}Cs was 1.32 ± 0.09 nCi, and that of stable Cs was 0.14 ± 0.01 mg. The ^{137}Cs content in the body of the teenagers, as determined by the whole-body counter, was 4.9 ± 0.7 nCi. The stable Cs content in the body of the teenagers was evaluated from the diet and the biological half-life, the latter value being determined from the long-term intake of ^{137}Cs and its body burden. The mean content of stable Cs was 0.53 ± 0.05 mg. (auth)

56527 PROGRAMS FOR AND EXPERIENCES IN ASSESSMENT OF RADIOACTIVE ORGAN AND BODY BURDENS IN PERSONNEL ENGAGED IN NUCLEAR OPERATIONS IN INDIA. Bhat, I. S.; Hukkoo, R. K.; Kamath, P. R.; Somasundaram, S. (Bhabha Atomic Research Centre, Trombay, India). pp 293-336 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Nuclear operations in India are spread over different parts of the country, each installation presenting characteristic problems of internal contamination. The operational philosophy adopted and the organization of programs for assessment of radioactive organ and body burdens in personnel engaged in nuclear operations in the country are discussed. The systems installed for direct assessment of organ and body burdens include shielded-chair and shadow-shield scanning-bed whole-body radioactivity monitors. The characteristics of these systems and the calibration and measurement procedures followed are described. Significant experiences with assessments of organ and body burdens in personnel employed in nuclear installations in India are reviewed. In Trombay, the typical cases of internal contamination come from radioisotope production, mainly ^{131}I, and the 40-MW(th) DIRUS, mainly ^{3}H. Fuel production has resulted in internal exposure to uranium. However, in none of the cases were the body burdens such that the subject had to be withdrawn from active work. With the commissioning of the 400-MW(e) BWR station at Tarapur in 1970, a vast amount of information has become available on internal exposure to activation products, such as ^{60}Co. Interestingly there have been a number of cases of internal exposure to radioiodine and radiocesium under normal operations and during maintenance. Assessments made by both whole-body counting and urine analysis have demonstrated the complementary role of the direct and indirect methods, especially in the follow-up of cases of accidental exposure. A study of personnel engaged in uranium mining and milling operations has shown that fingernail could serve as a good indicator tissue of internal contamination due to uranium. (auth)

56528 DIRECT METHODS USED AT THE CASACCIA NUCLEAR CENTRE TO ASSESS BODY BURDENS. Clemente, G. F. (CNEN, Rome). pp 337-49 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The two whole-body counters in operation at the Casaccia Nuclear Centre are used in health physics service and in research programs. The health physics service is concerned with the periodic checking of internal contamination of the employees at the Casaccia Nuclear Centre who are occupationally exposed to contamination hazards. This service, which began in 1967, was principally concerned up to 1970 with gamma-ray emitting radionuclides (fission and activation products such as ^{137}Cs, ^{134}Cs, ^{60}Co, etc.) measured by means of a standard chair geometry and an 8-in. × 4-in. NaI(Tl) crystal. Between 1967 and 1970 the internal contaminations giving serious doses to the employees were found to be due to only ^{131}I which had been administered for medical purposes. In four cases the calculated doses to the thyroid ranged between 142 rem and 1030 rem for the different individuals. In 1970, ^{239}Pu measurements in the lungs were started because a ^{239}Pu processing laboratory came into operation at the Casaccia Nuclear Centre. A normal 125-mm × 2-mm thin NaI(Tl) crystal, a proportional counter that we made outselves and a twin crystal comprising a 125-mm × 0.5-mm NaI(Tl) crystal optically coupled to a 5-in. × 2-in. CsI(Na) crystal with a pulse rise time discrimination were used for ^{239}Pu counting. The most sensitive method available at present seems to be the sandwich crystal which can detect 5 to 10 nCi of ^{239}Pu in the lungs. The research programs were mainly concerned with the study of K and Cs metabolism in the population by means of oral administration of ^{42}K and ^{132}Cs, and the measurement of K and ^{137}Cs in the excreta. A sex-related difference in the excretion rate of K and Cs was statistically demonstrated. Further studies are planned in order to account for this difference. (auth)

56529 CASE STUDIES OF ELIMINATION OF RADIOACTIVE CONTAMINANTS OBSERVED AT STUDSVIK BETWEEN 1963 AND 1970. Edvardsson, K. A. (Aktiebolaget Atomenergi, Studsvik, Sweden). pp 351-71 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The internal contamination of persons working with radioactive materials at Studsvik is checked by whole- or partial-body monitoring. The paper presents the results obtained in studies of the elimination of radioactive isotopes incorporated in man. Eight cases of contamination involving a total number of 11 individuals and 9 isotopes are analyzed for their elimination rate. Often it has been possible to make the first measurement shortly after the incident and to observe the rapid elimination during the first one or two days after contamination. In most cases the elimination can be described as a sum of two exponential functions. In one case three components in the elimination process were observed. The paper also gives the approximate effective half-lives and biological half-lives in days that were observed. (auth)

56530 MEASUREMENT OF INTERNAL CONTAMINATION OF RADIATION WORKERS BY THE FACTORY INSPECTORATE OF THE FEDERAL LAND OF NORTH RHINE-WESTPHALIA, FEDERAL REPUBLIC OF GERMANY. Rosenbaum, O. E. (Ministry of Labor, Health, and Social Affairs, Doesseldorf). pp 373-83 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

As from 1964, radiation workers in science, industry, and medicine are checked for internal contamination by means of urine analysis and by whole-body counting at the central laboratory of the Factory Inspectorate of the Federal Land of North Rhine-Westphalia. The central location of this whole-body counter operated by the state supervisory authority has enabled the operation of a well-organized program for all workers exposed to unsealed radioactive sources. The legal basis of the factory inspectorate's regulatory authority to determine a person's intake of radioactive substances in Section 37 of the First Radiation Protection Ordinance of 1960. The stipulations under which a person is required to submit to whole-body counting are laid down in a decree by the Ministry of Labour, Health and Social Affairs of North Rhine-Westphalia. The decree states the limits of activity handled for many nuclides, above which bioassay has to be carried out at regular intervals. Each working limit depends on the type of operation and the maximum permissible body burden of that nuclide. It is also indicated whether whole-body counting or urine analysis should be performed. The results of the surveillance program, which covers about 500 persons per year, show that in about 20% of the examinations incorporated activity could be determined. On the other hand, the number of cases in which the body content exceeded the maximum permissible body burden was quite low. This may be due to measures taken by the supervisory authority following the first indication of a possible intake given by the bioassay program. (auth)

56531 DESIGN AND IMPLEMENTATION OF BIOLOGICAL MONITORING PROGRAMS FOR TRITIUM. Stradling, G. N. (National Radiological Protection Board, Harwell, Eng.). pp 385-403 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The importance of biological monitoring for persons occupationally exposed to tritium is outlined, and the basic criteria affecting the implementation of such programs are discussed. The principal aims of monitoring are summarized, and the advantages of interpreting the data obtained in terms of the dose commitment to the critical organ are emphasized. Biological monitoring programs for persons exposed to tritium that is substantially catabolized to tritiated water are discussed in detail. It is shown that badly designed programs can yield erroneous data which could also unjustifiably affect a person's radiation status or livelihood. The correct design of the program for different categories of exposure are fully described with particular emphasis on the frequency of sampling and the interpretation of the data obtained; minimum levels below which results should be cited as negligible are proposed. The necessary modifications to the monitoring programs and probable errors in the interpretation of data are outlined where there may be exposures to labeled compounds that do not significantly catabolize to tritiated water. The necessity for authoritative advice and personal contact between the assay laboratory and the establishment where individuals are monitored is stressed. (auth)

56532 SOME PROBLEMS IN INTERPRETATION OF BIOASSAY DATA. Dolphin, G. W. (National Radiological Protection Board, Harwell, Eng.). pp 425-35 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

A review of the developments which have significantly influenced the interpretation of bioassay data since 1964 is presented. The most important of these is the report of the ICRP Task Group on lung dynamics which stresses the effect of particle size on deposition, clearance, and retention in the respiratory tract of inhaled radioactive particles. The effect of this report on the interpretation of data from nose blows, fecal excretion analysis, and chest monitoring is considered. Another development is the use of chromosome-aberration scoring in cultures of peripheral blood lymphocytes as a biological dose meter. The use of this technique for indicating the presence of significant quantities of radioactivity in the body is discussed. Probably the three most important radioactive materials currently used in the nuclear energy industry are tritium, natural and enriched uranium, and plutonium. These materials each present special problems in interpretation and are considered in detail. (auth)

56533 CHOICE OF A MODEL FOR THE INTERPRETATION OF EXCRETION AND RETENTION DATA. Nooteboom, G.; Nooteboom-Beekman, Zwanette M.; Ackers, J. G. (Reactor Centrum Nederland, Petten). pp 437-46 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Some problems concerning the choice of a mathematical model for the interpretation of radioisotope excretion and retention data are discussed. It is questioned to what extent power functions can represent excretion or retention after a single intake. With the aid of an example, based on the power, used in a power function representation of ^{85}Sr metabolism, it is shown that extrapolation of a power function, fitted to excretion or retention data, can lead to wrong estimates of the initial body burden and to serious mistakes in the estimation of the dose commitment, even if the time of the single intake is known. A connected problem is whether a multicompartment model can be derived from excretion or retention data. In another example it is shown that it may be necessary to collect these data during many years in order to estimate the half-life of the tail, i.e., the compartment with the longest half-life, which is generally the most important compartment for the magnitude of the dose commitment. In the example, which is also adapted to strontium metabolism, 10 years of urine sampling is insufficient to decide whether the tail has a half-life of 10^3, 5×10^3 or 10^4 days, even though the data are idealized (no additional intakes) and no scatter of data is included. The same difficulties are met in the interpretation of retention data, though in this example to a lesser extent. (auth)

56534 METHOD OF INTERPRETING EXCRETION DATA WHICH ALLOYS FOR STATISTICAL FLUCTUATION OF THE DATA. Snyder, W. S. (Oak Ridge National Lab., Tenn.). pp 485-94 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Langham used power functions to describe the trend of urinary and fecal excretion of plutonium in man following a single intravenous injection, fitting these functions to the excretion data of some 15 subjects. The author has fitted power functions $bt^{-\beta}$ to the excretion data of each patient, thus obtaining some indication of the range of individual variation that might be expected. For example, b ranged from 0.11 to 0.73 and β from 0.47 to 1.26 for the individual patients. Likewise, the extent of fluctuations about the individual's own curve and about an average or typical curve is determined. If U_t is the amount excreted on day t and $bt^{-\beta}$ is the individual's own excretion curve, then $U_t/bt^{-\beta}$ lies between 1/2 and 2 on about 50% of the days and between 1/3 and 3 about 80% of the sample days. In principle, such criteria make it possible to judge within broad limits the power function best fitting an employee's excretion data. The author has developed a computer code which adjusts both the parameters b and β of the power function by use of such criteria. Similar computer programs which make no allowance for statistical fluctuations of the excretion data generally overestimate the intake of plutonium, because each high fluctuation is considered as due to another intake of plutonium. By allowing an appropriate amount of fluctuation about the assumed trend curve, this tendency to overestimate intake is partially overcome. On the other hand, if β is too small, say, then the trend curve will be too flat and will tend to overpredict excretion systematically. On this basis, then computer then increases the value of β until the model and the data are broadly within the range of fluctuations usually found. The method is particularly useful for cases where a considerable body of excretion data are available, say, 20 or more excretion values which, however, need not be on consecutive days. The use of the method is illustrated by application to the data on the Langham subjects and on a few other cases. (auth)

56535 RADIATION DOSES IN RENAL CLEARANCE STUDIES. Kunkel, R.; Oberhausen, E. (Univ. of the Saarland, Homburg, Ger.). pp 509-14 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Investigations of the renal plasma flow with ^{131}I-Hippuran and of glomerula filtration rate with ^{51}Cr-EDTA or ^{169}Yb-EDTA by means of a whole-body counter method give quantitative information about the decrease in injected activity in the body, excluding the kidney—bladder region. The measurements are made in a whole-body counter with two 8-in. × 8-in. NaI(Tl)-detectors. Activity in the kidney—bladder region is screened by a 2-in. lead plate. The activity-time function is used to calculate radiation doses of the whole body, the kidneys, and the gonads for the three nuclides. Calculations of radiation doses in adults and children are demonstrated in cases of normal and pathological kidney function. (auth)

56536 MEASUREMENT OF ^{241}Am IN A TEN-YEAR-OLD BOY. Rundo, J.; Keane, A. T.; May, H. A. (Argonne National Lab., Ill.). pp 579-94 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

A four-year old boy acquired a burden of ^{241}Am, probably by inhalation, which was not detected until six years later. This paper describes the measurements which were made of the radiation emitted by the subject and the methods of calibration which were examined. The effects have been studied in tissue-like material on the scattering and absorption of the photons emitted by ^{241}Am. The most important observation was the non-exponential attenuation of the 60-keV gamma ray when determined under the broad-beam conditions necessarily used in the measurement of radioactivity in vivo. This and other results were used in the interpretation of the measurements. A very approximate value for the total body content was calculated from the results of a measurement with the subject in a tilting chair; the activity of an assumed value for the ^{40}K content was used as an internal standard. The result was 60 nCi, but this was considered only to indicate the order of magnitude. Detailed measurements were made with a large detector placed in five equally spaced positions over the supine subject. A phantom of Presdwood was used to determine a response matrix for a standardized source of ^{241}Am placed in turn in the five segments of the phantom and with the crystal placed at each of the five positions used for the measurements on the subject. Calibration data were also obtained by determining the geometric mean of the counts observed when a source was placed above and below the body of a control subject of similar build for each of the five crystal positions. Analysis of the results indicated a total content in the range 24 to 42 nCi; as much as 75% of it appeared to be in the upper half of the body. This suggested that as much as half of the total could be in soft tissue, presumably liver and/or lung. (auth)

56537 IN-VIVO MEASUREMENT OF ^{241}Am IN MAN. Wrenn, McD. E.; Rosen, J. C.; Cohen, N. (New York Univ., N. Y.). pp 595-618 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Six persons, ages 4 through 52, were chronically exposed by inhalation, over a period of six years, to a chemically unidentified form of ^{241}Am. In-vivo measurements were made with an 8-in.-diam. thin dual crystal spectrometer to assess organ and body burdens. Evaluation of the absolute amount of activity present by the meter arc technique is complicated because the 60-keV emission of ^{241}Am is highly self-absorbed in bone, and accordingly varies greatly with individual structure. The self-absorption was determined both from the use of tissue-equivalent phantoms and direct measurement of the absorbing ability of each subject, using a known ^{241}Am source. The spatial distribution in bone and in soft tissues was measured by measurements over various soft tissues and bone. The body burdens of two subjects who contained 40 and 90 nCi were easily measured in meter arc. Measurements over soft tissues showed little activity compared with measurements over bone, with the exception of the liver, and for one subject possibly the lung. Measurements over the thyroid area were not significantly different from those obtained over other soft tissues adjacent to bone or cartilaginous structures. The ratio of activity found in liver and the skeleton for a male adult and a child (age 10) were 0.1 and 0.3 respectively. Because of the paucity of animal data regarding this nuclide in species approximating man, two baboons were administered ^{241}Am intravenously and the distribution determined by in-vivo techniques and at autopsy one and three months post administration. In the baboon the liver was found to be a major locus of deposition, along with the skeleton, a pattern which is consistent with that observed in man chronically exposed. (auth)

56538 METHOD FOR EVALUATING ^{241}Am BURDENS IN THE LUNG. Gongora, G.; Gongora, R.; Jammet, H. (Institut du Radium, Paris). pp 623-33 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

In two subjects who had exhibited ^{241}Am contamination through the respiratory tract, the lung burden was evaluated with the help of an NaI-crystal detector. The evaluation was performed by orienting the dosimetric operation towards consideration of individual characteristics and construction of phantoms based on these characteristics. This consisted broadly in localizing the activity, which was pulmonary, and in taking thoracic measurements, isolating individual characteristics, and constructing a simple phantom on the basis of the latter. The phantom was of lamellar design, which made it possible to plot iso-efficiency curves in a plane with the help of a point source and deduce the amounts incorporated. The interest lies partly in the method used, which is based on considering individual characteristics and constructing a simple representative phantom, and partly in the fact that this evaluation procedure has had methodological implications for lung measurement. (auth)

56539 STUDY OF A CASE OF ACCIDENTAL CONTAMINATION BY TRITIATED WATER. Henry, P. (CEA, Bagnols-sur-Ceze, France). pp 641-57 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

During an accidental exposure of short duration a worker absorbed a quantity of tritiated water close to 100 mCi. The maximum specific activity of the urine (2240 μCi/liter) was found in specimens passed 4 hours after the incident. On the basis of the recommendations contained in ICRP Publication 2, the intake dose equivalent was estimated as 20 rem, which corresponds to 4 years of continuous exposure at the maximum permissible concentration (MPC). To speed up elimination of the tritium, the worker was placed on a regime involving an abundant intake of water, which was begun in hospital and continued, on a more moderate scale, at home. During this treatment the decrease in specific activity of the urine followed two exponential curves representing biological half-lives of 3.5 and 5.3 days. Elimination of the tritiated water was then continued under normal conditions of water intake, with a half-life of 7.5 days. The study of long-term elimination revealed a fourth exponential with a half-life of 63 days, which reflects the excretion of tritium exchanged with hydrogen in organic matter. Integration of the excretion exponentials made it possible to assess the dose equivalent delivered to the body water as 7.4 rem, the contribution of the last exponential (the long half-life) representing less than 1% of the total. The results obtained and the data currently available on long-term retention of tritium in the body suggest that the contribution of tritium fixed in the tissues did not exceed a few per cent of the total dose. (auth

56540 DOSE DISTRIBUTION AND MAXIMUM PERMISSIBLE BURDEN OF ^{125}I IN THE THYROID GLAND. Gavron, A.; Feige, Y. (Israel Atomic Energy Commission, Yavne). Health Phys.; 23: No. 4, 491-9(Oct 1972).

It is pointed out that a significant portion of the energy released by the decay of ^{125}I is carried by low energy Auger and internal conversion electrons, and that the range of these electrons is much smaller than the dimensions of a thyroid cell, causing a non-uniform dose distribution within an individual thyroid cell. The local energy deposition due to the decay of incorporated ^{125}I was calculated for a representative follicle model. The effects of variations in the biological parameters on the dose distribution were investigated. Allowing for the possibility that thyroid follicles of different sizes or shapes within the same thyroid gland may have different intake and excretion rates, a relationship between the follicle size and its relative iodine concentration was deduced. Choosing the dose rate at the cell-colloid interface as the limiting factor, a Maximum Permissible Thyroid Burden (MPTB) of 0.77 μCi ^{125}I for a 20 g gland was obtained. The corresponding MPC_a and MPC_w for radiation workers are 8×10^{-9} and 6×10^{-5} μCi $^{125}I/cm^3$, respectively. It is suggested that in view of some radiobiological evidence, an additional safety factor of about two may be desirable. (auth)

56541 CRITICAL ORGAN FOR TRITIUM GAS. McEwan, A. C. (National Radiation Lab., Christchurch, N. Z.). Health Phys.; 23: No. 5, 742-4(Nov 1972).

Skin has been taken as the critical organ for immersion in tritium gas although the maximum range of tritium β particles (about 0.6 mg/cm^2) is less than the thickness of the cornified layer of epidermal skin (7 mg/cm^2) and the average penetration of tritium β particles is only of the order of 1 mg/cm^2. It is considered that the lung should more appropriately be considered the critical organ. The calculation used by the ICRP to arrive at the MPC of tritium and inert gases in air for occupational exposure is shown not to apply for lung areas and an expression is derived for the dose rate to the walls of alveoli from tritium gas. These considerations also apply to ^{37}Ar, another very low energy radiation emitter. (UK)

Animals

Refer also to abstract 56137.

56542 (NIRS-Pu—7, pp 14-24) CHARACTERISTICS OF BODY RETENTION AND EXCRETION OF SOME RADIOACTIVE MATERIALS FOLLOWING THE INHALATION OF THEIR SUBMICRON AEROSOLS. Suzuki, Masashi; Watanabe, Seiki; Ohno, Shigeru; Hongo, Shozo; Ohata, Tsutomu (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

In order to obtain basic information relating to the change of body retention and excretion patterns of some mineral materials following the inhalation of their aerosols by adult Wistar rats, ^{144}Ce (half-life = 285 d), ^{65}Zn (half-life = 245 d), ^{7}Be (half-life = 54 d) with some amount of their carriers were administered to 10, 15, and 8 young rats respectively. An inhalation technique was used in which aerosols having a MMD of 0.3 to 0.6 μ were generated through Dautrebande Jet Generator D 30 a (modified) in forms of nitrate or sulfate. The method of inhalation exposure and measurement of body burdens and excreta are described elsewhere. The results showed that the pattern of change of body burdens of the three minerals was, in all cases, able to be expressed, in the first approximation, as bi-phasic exponential curves whose equation is to be described as $Bt = A_1e - \lambda_1^t + A_2e - \lambda_2^t$; where t is expressed in days. It was further revealed that λ_1 is in all cases fairly large, so that the half lives of the first phase exponential would all be in the range of 1.0 to 1.25 days. However, λ_2 may differ according to the kind and chemical form of the material. In our cases, Ce nitrate had a biological half-life of about 57 days, Zn nitrate about 30 days, and Be sulfate 33 days respectively. A_2 indicates the sector of the second phase exponential on the time 0, which may mean the proportion of aerosols deposited in the lower parts of the respiratory system approximately. Since more rapid transportability of Zn and Be into the body from the lungs than that of Ce is indicated, the proportion suggested by A_2 is about 55 to 60% in our cases, which is not similar to but not far from those obtained by us last year with $PrCl_3$. It also became clear that Ce remains in the lungs for a fairly long time, while Be and Zn are transferred to other parts of the body fairly rapidly. The minerals inhaled were excreted in the feces and the ratio of radioactivity in the feces to that in urine on the first or 2nd day were, in many cases, very high and more than one excepted in one case after one week, even in cases of Be which is said to be excreted mainly in urine. Thus, the importance of analysis of feces has particularly become evident in case of inhalation accident. (auth)

56543 (NIRS-Pu—7, pp 25-30) CHARACTERISTICS OF THE RETENTION AND EXCRETION OF Pu NITRATE IN WISTAR RATS

FOLLOWING INHALATION OF ITS SUBMICRON AEROSOLS. Suzuki, Masashi; Okabayashi, Hiroyuki; Watanabe, Seiki; Hongo, Shozo; Ohno, Shigeru (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

About 25 adult Wistar rats were exposed to submicron aerosols of Pu nitrate having a MMD of 0.25 μ, and the respiratory tract retention and fate of the Pu compound were investigated. The experimental methods of inhalation and measurement of lung burden and bioassay analysis were described elsewhere. Retained Pu compounds in the respiratory tract of rats measured by 60 kV gamma-ray (emitted by Am-241) changed, in the experimental group (six rats) during about one month, in the expression of the biphasic exponential model: $Bt = 0.35^{-0.7t} + 0.65e^{-0.023t}$ where Bt is the ratio of the t th day's lung burden of Pu against the initial burden and t is expressed in days. The range of mean half-life of the 2nd phase (at the 95% confidence level) in the experimental group was calculated as 26 to 37 days. Excretion of Pu was mainly observed in the feces on the first day following inhalation and the daily fecal excretion decreased to $\frac{1}{40}$ to $\frac{1}{100}$ of the total intake of Pu on the 3rd day and thereafter. The urinary excretion was less than $\frac{1}{10}$ of that of the feces. (auth)

56544 (NIRS-Pu-7, pp 38-41) INDIVIDUAL VARIATIONS OBSERVED IN THE WHOLE-BODY AUTORADIOGRAMS OF PLUTONIUM. Kashima, Masotoshi; Joshima, Hisamasa; Matsuoka, Osamu (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

Tests were conducted to determine whether or not the distribution patterns of plutonium vary among individual mice. Five male mice maintained under the same conditions were injected intravenously with about 1 μCi of ^{239}Pu (monomeric form) per mouse and were sacrificed 3 days after injection for a whole-body autoradiographic study of 40 μ thick frozen sections. The ^{239}Pu contents as specific activity in the tissues of each animal were determined by liquid scintillation counting using solvolyzer "Soluen". The result of the comparative inspection on autoradiograms (30 sections for each mouse) indicated no significant individual variations in the distribution pattern and the order of concentration level of ^{239}Pu in all tissues. Film density of autoradiogram and activity in tissue were grossly consistent. By visual inspection, a higher concentration level of ^{239}Pu in the red pulp of the spleen and in the lymph nodes was observed in only one mouse. This was assumed to be a reflection of an affected state in reticuloendothelial function. It is concluded, therefore, that the data obtained from whole-body autoradiography as to the distribution pattern and relative organ density may indicate very little variation in individual animals. (auth)

56545 (NIRS-Pu-7, pp 42-6) DISTRIBUTION OF PLUTONIUM FOLLOWING SUBCUTANEOUS INJECTION. Kashima, Masatoshi; Joshima, Hisamasa; Matsuoka, Osamu (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

Whole-body and micro autoradiographic studies were undertaken to clarify the relation between physicochemical form of Pu and its distribution pattern in all organs and tissues after subcutaneous injection. Twenty-two male mice were injected subcutaneously at the back region with Pu at a dose of 0.03 μCi/g body weight. The injected solution was prepared in the following three conditions: monomeric Pu solution with its pH adjusted to 1, 4.5, 7.2, and 13.0 immediately before injection; monomeric Pu solution at pH 7.2 stocked for 11 months; and polymeric Pu solution with its pH adjusted to 9.0. The mice were sacrificed at various time intervals ranging from 3 hrs to 56 days after injection. It was found that after subcutaneous injection of the monomeric form, ^{239}Pu remained mostly at the injected site for the entire period of 56 days studied. The concentration of Pu in bone appeared to increase with time up to 56 days. The level of Pu in the liver, especially around the central vein, was relatively high in the initial 3 days, but was lower at 21 or 56 days. It was relatively low in the spleen and lymph nodes, except in the regional lymph node. The distribution pattern of Pu following monomeric Pu injection was only slightly affected by changing pH or time prior to injection after preparation of the solution. In the case of polymeric plutonium, however, relatively low Pu concentrations were observed only in the bone and liver. In the microautoradiogram, single alpha tracks were observed to be randomly distributed in the liver, especially in significant number in the liver cells at 1 day after monomeric Pu injection, which is considered to represent the monomeric form of Pu. While the number of single alpha tracks appeared to decrease in the liver at 21 days postinjection, an aggregation of alpha tracks that could be interpreted as colloidal particles of Pu was found, though not so many, in the Kupffer cells of the liver, in the spleen, and in the lungs. (auth)

56546 (NIRS-Pu-7, pp 47-50) INFLUENCE OF THE ADMINISTRATION ROUTE WITH REGARD TO PARTICLE SIZE ON THE DISTRIBUTION PATTERN OF RADIOACTIVE PARTICLE IN MICE. Matsuoka, Osamu; Kashima, Masatoshi; Joshima, Hisamasa (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

Comparative studies on the distribution pattern of radionuclides in mice by whole-body autoradiography were carried out with special emphasis on the administration route with regards to their particle size. Three different radioactive particles such as 50 Å ^{198}Au colloid, 300 Å ^{198}Au colloid, and 5000 Å ^{32}P absorbed $Cr(OH)_3$ particles were selected as the testing material based on their particle size and the fact that they were well known and stable in the metabolic process. The radioactive colloidal or particle solution was injected into mice by three different administration routes (intravenous, intraperitoneal, and subcutaneous). From the comparative inspection of whole-body autoradiograms, a general rule for the distribution pattern of radioactive particles depending on their particle size was extracted. All colloids and particles in the range of 50 Å to 5000 Å were accumulated into the RES (reticulo-endothelial system) organs. Their clearance rate was dependent on the particle size. On size dependency of organ uptake, the smallest particle size selectivity was in bone marrow and the largest was in spleen. In intraperitoneal injection, the final deposition of particles through the peritoneal cavity was nearly identical to those given by intravenous injection though their arrival time is considerably delayed. All size range particles tested were retained at the mediastic lymph nodes during 15 min to several hrs after injection. In the subcutaneous route, the injected particle was selected on the basis of particle size at the injected site, the smaller particles being more transportable. The marginal size for transportable particles was around 300 Å. Particles in the 5000 Å size range were not transported. (auth)

56547 (NIRS-Pu-7, pp 57-61) EFFECTS OF Ca-DTPA ON THE WHOLE BODY RETENTION AND THE TISSUE DISTRIBUTION OF MONOMERIC Pu AND POLYMERIC Pu. Joshima, Hisamasa; Matsuoka, Osamu; Kashima, Masatoshi (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

Little is known about the effect of Ca-DTPA on the whole body retention of Pu. The present study is designed to determine the effects of Ca-DTPA on the tissue distribution with regards to the whole-body retention of monomeric and polymeric Pu. A single intravenous injection of 1 μCi (about 0.03 μCi/g body weight) of monomeric Pu or polymeric Pu was given to 46 male mice. On the day after injection of Pu, six mice that were given monomeric Pu were sacrificed to determine the tissue distribution as control, and the first of 12 intraperitoneal injections of Ca-DTPA, or of saline, spaced 3 days apart, was given to the other 40 mice. The individual dose of Ca-DTPA was 100 mg/kg body weight. During the experimental period, the whole-body activity determinations were performed with three thin NaI (Tl) crystals. Immediately before the mice died, the liver, spleen, and salivary gland were removed and analyzed for Pu using the liquid scintillation counter. From the results of whole-body retention, monomeric Pu was more readily excreted than polymeric Pu and, also, the effect of Ca-DTPA on the excretion of polymeric Pu was smaller than on that of monomeric Pu. It seemed that the effect of Ca-DTPA on the excretion of Pu, both monomeric and polymeric, gradually decreased with time. The tissues distribution data indicated that the monomeric Pu contained considerable amounts of polymeric Pu. In liver and salivary gland, monomeric Pu, which existed mainly in the extracellular fraction, was easily chelated by Ca-DTPA. On the other hand, polymeric Pu, which was engulfed by the splenic reticuloendothelial cells, was not chelated because the cell membranes are relatively impermeable to Ca-DTPA. But even if Ca-DTPA could permeate the cell membrane, engulfed polymeric Pu would not be chelated because of its physicochemical property. From the discussion of the present results, new concepts on Ca-DTPA chelatable Pu and Ca-DTPA unchelatable Pu were proposed. Because all of the chelatable Pu was excreted, the latter Ca-DTPA treatments had little effect on the whole-body retention of Pu. (auth)

56548 (NIRS-Pu-7, pp 61-4) DISTRIBUTION OF PLUTONIUM FOLLOWING INHALATION OF PLUTONIUM NITRATE AEROSOL IN RAT. Matsuoka, Osamu; Joshima, Hisamasa; Kashima, Masatoshi (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

The whole-body distribution of inhaled plutonium in rats was investigated by whole-body autoradiography. Plutonium nitrate aerosol (MMD = 0.35 μ) was inhaled by Wistar rats for 30 min. Freeze-dry sections of the whole body and isolated lung from the rats were contacted with x-ray film. On the whole-body autoradiograms obtained from the specimens 1 day after exposure, plutonium was located mainly in the lungs and very small amounts of plutonium were observed in intestine. The autoradiogram of the isolated lung section obtained from the rat sacrificed immediately after inhalation showed remarkable deposition of plutonium in the tracheo-bronchial and pulmonary region. One month after inhalation, it was demonstrated that the plutonium deposited in the lungs still remained, with very small amounts translocated to the trabecular bone of the vertebra and to the ilium. Isolated lung specimens obtained at the same time showed no deposition in the tracheo-bronchial region and very little deposition in the pulmonary region. (auth)

56549 (NIRS-Pu–7, pp 70-2) EFFECT OF DTPA TREATMENT ON ACUTE TOXICITY IN MICE. Matsuoka, Osamu; Joshima, Hisamasa; Kashima, Masatoshi (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

The effect of repeated DTPA treatments on the acute toxicity of monomeric and polymeric Pu was investigated regarding whole-body retention, survival time, and body weight change. Monomeric and polymeric plutonium (0.03 μCi/g) were given to mice intravenously. One day after injection, a Ca-DTPA saline solution was administered (100 mg/kg) repeatedly to mice intraperitoneally spaced 3 days apart. Whole-body retention of both treated and untreated groups of the two different plutonium forms were measured and three additional groups, i.e., DTPA-chelate Pu, monomeric + DTPA, and polymeric + DTPA were also measured to compare. The whole-body retention of the six groups showed the following order of higher retention; polymeric, monomeric, polymeric and DTPA treatment, polymeric + DTPA, monomeric and DTPA treatment, monomeric + DTPA, and DTPA-chelate Pu. Repeated DTPA treatment produced a remarkable decrease in body retention depending on the physicochemical form of the plutonium. Survival time and body weight change were, however, not so affected by DTPA treatment although the mean survival time depended on the initial physicochemical state. (auth)

56550 INCORPORATION OF RADIOACTIVE COBALT INTO THE EGGS OF DOMESTIC FOWLS. Matsusaka, N. (Iwate Univ., Japan); Nishimura, Y.; Ichikawa, R. J. Radiat. Res.; 13: No. 3, 156-62(Sep 1972).

The transfer rate of radioactive cobalt to the eggs of hens and Japanese quails was investigated. No activity was found in the 1st egg laid within 24 hrs after oral dosing in both species of birds. When ^{60}Co was given orally to the laying hens, the ^{60}Co content in the yolks became higher in the 2nd and 3rd eggs followed by a marked decrease with time. The cumulative amount of ^{60}Co in the hen's egg yolks for 14 days after oral dosing was estimated to be around 0.1% of the dose. In addition, the ^{58}Co content in the yolks was measured in the Japanese quails after single or daily intraperitoneal injection. It was found for both modes of administration that the radioactive cobalt was mainly incorporated into the egg yolk, and very little to the albumen and shell, if any. Moreover, the whole-body retention of ^{58}Co was investigated after single or daily intraperitoneal injection in the Japanese quails. (auth)

56551 ACCUMULATION AND WAYS OF ENTRY OF ^{35}S FROM SODIUM SULFATE AND METHIONINE IN THE ORGANISM OF FASTING LOACH (MISGURNUS FOSSILIS L.). Nefedova, A. I. pp 154-60 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The entry of sulphur-35 and its accumulation in the organism of the loach were studied using solutions of sodium sulphate and methionine with a specific activity from 40 to 400 μCi. The duration of the experiments ranged from 3 to 72 hrs. It was found that the accumulation of sulphur-35 increases with increasing specific activity of the solutions and duration of the experiments. Sulphur-35 accumulates in muscle tissue in insignificant amounts from methionine and does not accumulate at all from sodium sulphate. When incorporated in muscle tissue it becomes partly bound with the muscle albumin myosin. The entry of sulphur-35 from sodium sulphate and methionine in the organism of the loach is accomplished through the cephalon only. (auth)

56552 RADIOECOLOGICAL GROUPS OF MAMMALS AND BIRDS IN BIOGEOCENOSES OF REGIONS WITH A HIGH NATURAL RADIOACTIVE BACKGROUND. Maslov, V. I.; Maslova, K. I. pp 161-73 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

As a result of complex radioecological investigations carried out in biogeocenoses with a high radioactive background, a classification was developed of the mammals and birds of the northern taiga. According to this classification, the animals are divided into three radioecological groups; of close, moderate, and slight contact with radioactive substances and sources of radioactivity. The radioecological classification is based on the intensity of uranium, radium, and thorium accumulation in the animal organism, the specific ecological features of the habitat, and the changes produced in certain morphological characters by the effect of high natural radioactivity. (auth)

56553 SOME PROBLEMS OF THE RADIOECOLOGY OF THE OTTER IN BIOGEOCENOSES OF THORIUM REGIONS. Maslov, V. I.; Maslova, K. I. pp 173-91 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Investigations were carried out in which new data were obtained on the ecology of the otter, as well as materials that permit to characterize the complicated radiation environment of different sites within the home range of the animal. The radioactivity of the water and ground of bodies of water was determined and the radiation levels of coastal zones, homes, and refuges were established. It was found that under the conditions of a thorium biogeocenosis all the foodstuffs of the otter are characterized by a high uranium, radium, and thorium content. The quantities of these elements incorporated in the tissues and organs of the animals exceed by 10 to 40 times their content in the body of otters living in biogeocenoses with normal radiation conditions. In animals constantly exposed to the effect of a high radiation background, some morphological changes take place in the structure of the skin and hair cover in separate parts of their pelt. (auth)

56554 RADIOECOLOGY OF GROUSE IN BIOGEOCENOSES OF THORIUM REGIONS. Maslov, V. I. pp 191-215 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

A study was made of the ecology of grouse (wood grouse, black grouse, hazel grouse, and white grouse) living in biogeocenoses with a high radioactive background. The diet of the birds during snow and snow-free periods was investigated. Data are presented on the content of radium, uranium, and thorium in the different components of the diet and gastroliths and on the content of radioelements in the organs and tissues of birds living in biogeocenoses with a high radioactive background. The effect is shown of the factor of high radioactivity on the weight, and fatness of the birds and their infection with parasites. (auth)

56555 FALLOUT ^{137}Cs AND ^{90}Sr IN TROUT FROM MOUNTAIN LAKES IN COLORADO. Whicker, F. W. (Colorado State Univ., Fort Collins); Nelson, W. C.; Gallegos, A. F. Health Phys.; 23: No. 4, 519-27(Oct 1972).

Concentrations of ^{137}Cs and ^{90}Sr were measured in trout from 51 mountain lakes in Colorado during the period 1965 to 1970. Cesium-137 levels ranged from 116 to 5802 pCi/kg wet muscle while ^{90}Sr values ranged from 6 to 238 pCi/g bone ash. A yearly decrease in ^{137}Cs levels was observed with the rate of decrease becoming smaller through the sampling period. The temporal trend was fit by a model employing a fallout rate factor and a cumulative deposition factor. Radionuclide concentrations generally were higher at the more northerly latitudes. Trout from lakes in certain watersheds were much higher in ^{137}Cs than trout from other regions. Trout from montane and alpine lakes contained much more ^{137}Cs and ^{90}Sr than fish from waters at lower elevations. Dissolved calcium was significantly related to ^{90}Sr values in trout, but potassium had no demonstrable effect on ^{137}Cs values. A trophic relationship of 3.26 was found for ^{137}Cs between large trout and small trout that presumably were the prey. General lake characteristics associated with relatively high ^{137}Cs and ^{90}Sr burdens in trout are described. (auth)

56556 METABOLIC AND THERAPEUTIC STUDY FOLLOWING ADMINISTRATION TO RATS OF ^{238}Pu NITRATE. A COMPARISON WITH ^{239}Pu. Morin, M.; Nenot, J. C.; Lafuma, J. (CEN, Fontenay-aux-Roses, France). Health Phys.; 23: No. 4, 475-80(Oct 1972).

Rats were administered ^{238}Pu or ^{239}Pu nitrate either intramuscularly or by aerosol. Uptake from the site of injection was faster with ^{238}Pu, whereas the opposite process was noticed after inhalation. The respective bone burdens following intramuscular injection were of the same order provided they were related to the diffused fraction. The metabolic fate of both isotopes was different; there was greater early ^{238}Pu urinary excretion. Following inhalation, ^{238}Pu deposition in bone was higher. Treatment by DTPA was effective against ^{238}Pu contamination. (auth)

56557 REDUCTION IN THE RETENTION OF RADIOACTIVE BARIUM IN RATS FOLLOWING THE ADDITION OF SODIUM ALGINATE DERIVATIVES TO THE DIET. Sutton, A.; Humphreys, E. R.; Shepherd, H.; Howells, G. R. (Medical Research Council, Harwell, Eng.). Int. J. Radiat. Biol.; 22: No. 3, 297-300(Sep 1972).

Using ^{131}Ba or ^{133}Ba, a comparison was made in rats, of the effect of three alginate derivatives on the retention of orally administered barium, and the retention and excretion of an injection of barium. The three derivatives, tested in the form of a 10% addition to the diet, were Manucol SS/LD2, OG1, and 50M. The retention of orally administered barium on the 7th day by the rats receiving SS/LD2, OG1, or 50M was 1/8, 1/8, and 1/4, respectively. Four days after parenteral administration, the carcass content of the marker was 5 to 12% lower in the alginate-fed rats. The reduction in retention was accompanied by a small but significant increase in fecal excretion and it is suggested that one mechanism of alginate action is by inhibition of re-absorption of barium from the gut. It is pointed out that the alginate 50M has a lower guluronic acid content (90%) than OG1 (95%), but the low effectiveness of 50M is more likely to be due to its chemical instability. (UK)

56558 EFFECTIVENESS OF DTPA FOR THE REMOVAL OF IN VIVO ^{144}Ce ACCOMPANIED WITH DIFFERENT LEVELS OF CARRIER. Takada, K. (Japan Atomic Energy Research Inst., Tokai). Health Phys.; 23: No. 4, 481-9(Oct 1972).

A study was undertaken to investigate the effect of DTPA for removing ^{144}Ce injected with different levels of carrier in rats. To test the effect, rats were administered intraperitoneally 1.5 m-mole/kg of DTPA, 1 hr after ^{144}Ce i.v. injection. Daily urinary and fecal excretions of ^{144}Ce of the treated and control rats were determined for 15 days following ^{144}Ce injection. The tissue distribution of the ^{144}Ce on the 15th day also was determined. Although addition of 13 micromoles of carrier/kg of body weight markedly reduced the effectiveness of DTPA, the carriers between 1.3×10^{-2} and 1.3 μ-mole/kg did not reduce the effectiveness of DTPA, but rather seemed to enhance it. (auth)

56559 TISSUE DISTRIBUTION OF ACCUMULATED RADIONUCLIDES IN FRESHWATER CLAMS. Harrison, F. L.; Quinn, D. J. (Univ. of California, Livermore). Health Phys.; 23: No. 4, 509-17(Oct 1972).

The distribution of accumulated ^{46}Sc, ^{51}Cr, ^{54}Mn, ^{59}Fe, ^{60}Co, ^{65}Zn, ^{155}Eu, ^{182}Ta, ^{203}Hg and ^{210}Pb were determined singly in freshwater clams (Anodonta nuttalliana Lea) after a 10 to 12 day exposure to low concentrations in solution and/or suspension in their aquarium water. All radionuclides were detected in internal tissues and organs, indicating transfer across the gut and/or exterior surface and circulation by the body fluid. The distribution in the 12 different tissues and organs examined varied with the radionuclide. High concentrations of ^{54}Mn, ^{60}Co, ^{65}Zn and ^{210}Pb were found in the calcareous tissue whereas high concentrations of the other radionuclides were found in organs of the digestive system. Valence state appeared to affect distribution. Those in high concentrations in the calcareous tissue were in the divalent state whereas those in the digestive organs were in the trivalent or higher state. Of the total activity in the soft tissues, the fraction in the internal tissues varied with the radionuclide. Most radionuclides underwent changes in physical state during the experiment. Although initially all but ^{182}Ta were in solution, at termination a significant fraction was associated with particles. Depletion of some radionuclides from the water appeared to result primarily from physical and chemical rather than biological processes. (auth)

56560 ACCUMULATION OF RADIOACTIVE CESIUM, PHOSPHOROUS, STRONTIUM, AND YTTRIUM BY MOSQUITO LARVAE AND ITS RELEVANCE TO RADIATION DOSE. Scott, A. G.; Guthrie, J. E. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Can. J. Zool.; 50: No. 6, 767-70(Jun 1972). (AECL—4177).

Aedes aegypti (L.) larvae were reared in solutions of ^{137}Cs, ^{32}P, and ^{90}Sr + ^{90}Y and the apparent concentration ratios of the individual radionuclides that were accumulated are reported. A consideration of the significance of accumulation to the internal radiation dose delivered to the larvae reveals that larvae reared in identical concentrations of a radionuclide did not receive the same dose, nor were they exposed to the greatest dose-rate at the same stage of development. The probable dose to larvae reared in radioactive solutions cannot be calculated solely from a knowledge of the radionuclide concentration in the rearing medium. (auth)

56561 CLEARANCE OF ^{232}Th AND DAUGHTERS FROM THE BLOOD. Kaul, A. (Freie Univ., Berlin); Heyder, J. pp 469-81 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Colloidal thorium dioxide (Thorotrast) was widely used as a radiological contrast medium between 1930 and 1950. Since Thorotrast is eliminated from the body only to a negligible degree, Thorotrast patients constitute a population that is being exposed to a long-term internal irradiation. The estimation of the dose rate from deposits of Thorotrast within the human body, however, is complicated by the different metabolic behavior of the thorium daughters. Therefore experiments have been done with rabbits in order to study the kinetics of distribution and excretion of ^{232}Th and its daughters after injection of Thorotrast into the blood. The object of the present study was to investigate the clearance from the blood of thorium decay products which were present in soluble (ionic) form or were located in the particle fraction of the Thorotrast . The amount of ^{228}Ra, ^{228}Th, and ^{224}Ra injected in a soluble or colloidal form was determined either experimentally by ultracentrifugation of Thorotrast samples or by means of a theoretical model, assuming spherical ThO_2 particles following a Maxwell distribution and recoil of thorium daughters due to alpha decay. The results of the animal experiments indicate an extremely low rate of clearance from the blood of the thorium daughters in colloidal form during the primary phase of retention (about 1 hr). Thereafter, an increase in the rate of disappearance of colloidal thorium-decay products occurs corresponding to a half-life of about 90 min. Thorium daughters in soluble form proved to be retained with a half-life of about 75 min. (auth)

56562 EVALUATION OF THE BURDEN OF THE ISOTOPES ^{210}Pb, ^{210}Bi, AND ^{210}Po IN THE ORGANS OF RATS CONTAMINATED THROUGH THE RESPIRATORY TRACT WITH RADON AND ITS DAUGHTER PRODUCTS. Furnica, Gh.; Toader, Maria (Institut d'Hygiene et de la Sante Publique, Bucharest). pp 543-62 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972). (In French).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

Two groups of white rats were contaminated with radon and its daughter products for 30 to 60 days through the respiratory tract. Urine and fecal materials were collected during the period when contaminated air was inhaled and the content of ^{210}Pb, ^{210}Bi, and ^{210}Po was determined. The animals were sacrificed 52 and 24 days after the end of the 30- and 60-day inhalation periods, and the content of the above isotopes was determined in the lung, kidney, bone, and liver. The results are discussed in relation to the distribution of these isotopes in the body in relation to post-inhalation time. (auth)

56563 ESTIMATION OF ABSORPTION COEFFICIENTS FOR ^{54}Mn AND ^{47}Ca IN DAIRY COWS BY WHOLE-BODY COUNTING. Sansom, B. F. (ARC, Compton, Eng.). pp 563-76 of Assessment of Radioactive Contamination in Man. Vienna; International Atomic Energy Agency (1972).

From Symposium on assessment of radioactive organ and body burdens; Stockholm, Sweden (22 Nov 1971). See STI/PUB—290; CONF-711104.

The estimation of the retention of radioactive elements taken up in their diet by large farm animals is particularly difficult because of the large quantities of excreta they produce, and the resultant difficulties in achieving complete collection and adequate sampling before radioactive estimation for balance calculation purposes. When the absorption of the element, and thus the whole-body retention, is small the risk is practically impossible because of the unavoidable errors in estimating excretory output. For this reason a whole-body counter is an essential tool for measuring the retention of poorly absorbed minerals from the diet of such animals. However, although a whole-body counter can measure accurately the retention of an oral dose of an element at various times after administration, the estimation of the absorption coefficient of the element is not thereby directly solved. Since a knowledge of the absorption coefficient is essential to an understanding of the metabolism of the element such an estimation is important. Results obtained with the Compton whole-body counter on the retention of ^{54}Mn and ^{47}Ca by cattle, at various times after oral and intravenous doses of the nuclides as $^{54}MnCl_2$ and $^{47}CaCl_2$ respectively, are presented. A method for deconvoluting the oral and intravenous dose-retention curves in order to give absorption coefficients for manganese and calcium will then be presented. A computer program for solving the simple but laborious equations has been developed. A possible refinement of the method using a non-absorbed marker and double-isotope counting when measuring the oral-dose retention curve will also be described. The significance of the method for general application to mineral absorption problems, in human beings as well as animals, is discussed with particular reference to calcium metabolism. (auth)

56564 RADIATION DOSE FROM NEAR-IN FALLOUT PARTICLES. Lovaas, Arvin Irving. Fort Collins, Colo.; Colorado State Univ. (1972). 148p. University Microfilms Order No. 72-22,575.

Thesis.

Experiments were done to measure the retention of simulated near-in fallout by unsheltered livestock and agricultural crops. A simulant of Lutetium-177 labeled sand (1 μci/g) in size ranges 88-175 and 175-350 μm was used. Retention was little affected by particle size in the two ranges tested or by mass loading from 1 to 100 g/m^2. Retention of simulant on the backs of Holstein cows and Hereford—Angus cows and calves was measured. The latter set were observed for weathering of retained particles in both pasture and feedlot. Typical average initial retention of particles on cows' backs was about 50%, the small of the back showing complete initial retention and little or no weathering loss. Gastrointestinal excretion of fallout simulant particles ingested by the cow and sheep was measured in related experiments. Excretion lifetimes of about 5 days for the cow and 1 day for sheep were found. Field crops of alfalfa, irrigated pasture bromegrass, sudan grass, corn, barley and sugarbeet tops were tested for their retention of simulated fallout. It was found both in laboratory test chamber studies and for the field releases that retention by dense plant canopies could approach 100% when the crop canopy was wetted, even though the canopy retained only 20% or less of incident particles under unwetted conditions. Measured initial retentions for pasture bromegrass, alfalfa and corn were typically 5 to 10%, 5 to 20%, and 30 to 50% respectively. Halftimes of weathering loss from crops were typically a week or less. Heavy retention caused by moist surfaces may be responsible for greatly increased dose but when the surfaces dry, the excess retention is rapidly lost from them. Wind-storms and rains of the order of 2.5 cm reduced crop retention of simulant by a factor of 2 or more. For material deposited in fair weather, weathering loss was not rapid enough to be important compared to reduction of dose due to decay of fission products. Measured retention values are applied to an assumed fallout deposition density of 1 Ci/m^2 such as might occur at one day post fission at a distance of about 90 miles from a megaton explosion. Estimated beta and gamma doses are presented using results of analysis of the contamination of ground surface, animals and vegetation. Doses to both crop and cows in the three days post deposition are treated by the approximate calculations. Both uniform distribution and nodal aggregations of fallout particles are considered. Evidence is presented on the manner in which the retention of simulated fallout and by implication actual radiation dose due to particles of fallout is sensitive to the target crop, deposition conditions and subsequent weathering. (Diss. Abstr. Int., B)

56565 REMOVAL OF INHALED ^{144}CeCl$_3$ FROM BEAGLE DOGS. 3. BILATERAL BRONCHOPULMONARY LAVAGE WITH A DTPA SOLUTION. Muggenburg, B. A.; Pfleger, R. C.; Cuddihy, R. G.; McClellan, R. O. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Health Phys.; 23 No. 5, 611-19(Nov 1972).

The effectiveness of bilateral bronchopulmonary lavage with a diethylenetriaminepentaacetic acid (DTPA) solution or an isotonic saline solution for removing ^{144}Ce was investigated in Beagle dogs that had inhaled ^{144}CeCl$_3$. Two dogs were lavaged with a DTPA solution on days 0 and 5 after ^{144}Ce exposure, 2 on day 0 only and 2 on day 5 only. Two other dogs were lavaged with an isotonic saline solution on days 0 and 5 post-exposure. Although some ^{144}Ce was removed in the lavage fluid, DTPA treatment removed more through enhanced urinary ^{144}Ce excretion. The effectiveness of bilateral bronchopulmonary lavage treatment with the saline or the DTPA solutions was compared with the effectiveness of unilateral bronchopulmonary lavage and the intravenous administration of both solutions. The most effective treatment was bilateral bronchopulmonary lavage with DTPA on days 0 and 5 after inhalation of ^{144}CeCl$_3$ which resulted in the greatest reduction in the percentage initial lung burden in lung, liver, and skeleton of the treated dogs as compared to untreated control animals. (auth)

56566 STRONTIUM UPTAKE AND THE ORGANIC MATRIX OF THE METAPHYSEAL AND DIAPHYSEAL BONE IN RAT. Hong, K. C.; Iida, K.; Cruess, R. L. (Royal Victoria Hospital, Montreal). Can. J. Physiol. Pharmacol.; 50: No. 8, 735-9(Aug 1972).

The ^{85}Sr uptake and the phospholipid, collagen, and mucopolysaccharide content of metaphyseal and diaphyseal rat bone were investigated. ^{85}Sr uptake was higher in the metaphysis, which contains more organic material, than in the diaphysis. Metaphyseal bone contained more phospholipid, proline, hexosamine, and hexuronic acid, but less hydroxyproline, than diaphyseal bone. Lecithin, phosphatidylethanolamine, and sphingomyelin were the principal phosphatides of both regions of bone; metaphyseal bone contained slightly more lecithin but there were no significant differences in the percentages of the other two neutral phosphatides. The ratio of hexosamine to hexuronic acid was 1.1 for the metaphysis and 2.4 for the diaphysis. Intravenous administration of polyuronides led to a significant decrease in the strontium uptake of bone. (auth)

56567 ACCUMULATION OF ^{137}Cs BY AEDES AEGYPTI LARVAE AND THE EFFECT OF POTASSIUM CONCENTRATION. Guthrie, J. E.; Burzynski, A. Z. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Can. Entomol., 104: No. 3, 411-6(Mar 1972). (AECL-4110).

Radiocesium accumulation by Aedes aegypti larvae was greater at 25°C, than at 20°C. The activity density (c.p.m./mg dry wt.) of the adults was the same for both sexes, as was the nuclide's elimination rate. The amount of ^{137}Cs accumulated by the larval instars was inversely proportional to the concentration of potassium in the rearing medium, the suppression of ^{137}Cs uptake being greater at 25°C than at 20°C. The possibility that larvae may accumulate ^{137}Cs via the anal papillae and the gut is briefly discussed. (auth)

56568 REMOVAL OF INHALED ^{144}CeCl$_3$ FROM BEAGLE DOGS. 2. INTRAVENOUS ADMINISTRATION OF A DTPA SOLUTION. Pfleger, R. C.; Muggenburg, B. A.; Cuddihy, R. G.; McClellan, R. O. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Health Phys.; 23: No. 5, 605-9(Nov 1972).

Intravenously administered diethylenetriaminepentaacetic acid (DTPA) was beneficial in removing ^{144}Ce from dogs after inhalation of a ^{144}CeCl$_3$ aerosol; however, the effectiveness depended upon early treatment in dogs given DTPA 1 hr after the inhalation exposure. The lung, liver and skeletal burdens after 28 days were reduced to 40, 36 and 27%, respectively, of the initial lung burden of the exposed untreated control group. DTPA treatment initiated at 5 days post-inhalation of ^{144}CeCl$_3$ resulted in a 50% reduction in the lung burden with very little effect on the liver and skeletal burdens. The urinary excretion of ^{144}Ce increased to 8 times the control level in the animals treated with DTPA on day 0 but in the animal treated on day 5 the urinary excretion was only 2 times that of the control. An animal injected intravenously with sterile isotonic saline 1 hr after an exposure to a ^{144}CeCl$_3$ aerosol had lung, liver and skeletal burdens and a urinary excretion pattern not significantly different from the exposed untreated control dogs. Comparisons of the data are made with those from a study in which DTPA was added to the fluid used for bronchopulmonary lavage. (auth)

56569 REMOVAL OF INHALED ^{144}CeCl$_3$ FROM BEAGLE DOGS. 1. UNILATERAL BRONCHOPULMONARY LAVAGE WITH A DTPA SOLUTION. Pfleger, R. C.; Muggenburg, B. A.; Sesline, D. H.; (and others) (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Health Phys.; 23: No. 5, 494-603(Nov 1972).

Bronchopulmonary lavages of the left lungs of Beagle dogs, with isotonic saline or diethylenetriaminepentaacetic acid (DTPA) in saline as lavage media, were performed following a single inhalation exposure of the animals to a ^{144}CeCl$_3$ aerosol. Cerium-144 was removed from the lung in the lavage fluids. Lavage with the DTPA solution in contrast to lavage with the saline solution resulted in an increased urinary excretion of ^{144}Ce. When the dogs were sacrificed 28 days post-exposure, the concentration of ^{144}Ce in the lavaged left lung was less than in the untreated right lung. The sacrifice body burdens of ^{144}Ce as a percentage of the initial lung burden were lower in the treated animals than in the control animals. The 28-day cumulative radiation dose to the lungs, liver and skeleton of dogs lavaged with the DTPA solution on the day of exposure were 49, 34 and 36%, respectively, of those in the control group. A DTPA lavage was found more effective than a lavage with isotonic saline solution. (auth)

56570 BIOLOGICAL MODEL DESCRIBING TISSUE DISTRIBUTION AND WHOLE-BODY RETENTION OF BARIUM AND LANTHANUM IN BEAGLE DOGS AFTER INHALATION AND GAVAGE. Cuddihy, R. G.; Griffith, W. C. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Health Phys.; 23: No. 5, 621-33(Nov 1972).

Whole-body retention and tissue distribution of inhaled ^{140}Ba–^{140}La and whole-body retention of ingested ^{133}Ba were studied in Beagle dogs after administration in soluble chloride forms. The resulting data were used to formulate a biological retention model which was executed with both analog and digital computer methods. This model was then used to estimate radiation protection guidelines for human exposure to soluble and relatively insoluble aerosols of ^{140}Ba and ^{133}Ba. The biological tissues receiving the most significant radiation doses were predicted to be the skeleton after inhalation of ^{140}BaCl$_2$ and ^{133}BaCl$_2$ and the lung after inhalation of ^{140}BaSO$_4$. The influence of species differences, age, dietary state at the time of inhalation exposure and aerosol particle size upon the calculation of (MPC)$_a$ guidelines was also discussed. (auth)

56571 EXPERIMENTAL REMOVAL OF ^{144}Ce, ^{241}Am, ^{242}Cm, AND ^{238}Pu FROM THE RAT SKELETON. Nenot, J. C.; Morin, M.; Skupinski, W.; Lafuma, J. (CEN, Fontenay-aux-Roses, France). Health Phys.; 23: No. 5, 635-40(Nov 1972).

The therapeutic effectiveness of DTPA on bone deposits of lanthanide or transuranic elements can be appreciable when the greater part of the activity is to be found in bone. This was obtained after 3 weeks time following the administration by inhalation of ^{144}Ce and ^{241}Am and by intramuscular injection of ^{242}Cm and ^{238}Pu. DTPA therapy starting after this delay decreased bone burdens by a factor from $\frac{1}{2}$ to $\frac{1}{3}$ in 3 months. There probably exist two different compartments which would clear, under the influence of DTPA, with a half-life of 2 months for the former and very slowly for the latter. The effectiveness of DTPA on the second compartment could not be estimated. (auth)

Plants

Refer also to abstract 58386.

56572 (AECL—4213, pp 29-41) ENVIRONMENTAL RESEARCH. Jun 1972.

Progress is reported on off-site monitoring; liquid disposal area; liquid effluent monitoring; tritium survey; fate of radionuclides in aquatic ecosystems; studies on ^{60}Co and ^{90}Sr in Perch Lake Basin; St. Lawrence River studies; Perch Lake evaporation study; atmospheric dispersion studies; environmental pollution studies; permanent storage of high-level wastes; effects of nutrient enrichment on primary production; environmental radioactivity studies; and evaporation studies. (H.L.W.)

56573 (UCB—34-P-23-X-4) BEHAVIOR AND EFFECTS OF RADIONUCLIDES IN SOILS AND PLANTS. Babcock, K. L.; Handley, R.; Schulz, R. K. (California Univ., Berkeley. Dept. of Soils and Plant Nutrition). 1 Jul 1972. Contract AT(04-3)-34. 70p. Dep. NTIS.

The uptake of Sr by the excised roots of corn (Zea mays L. var. Golden Cross Bantam) involves a metabolic accumulation mechanism which appears to be the same as that responsible for K uptake. Although K interferes seriously with the accumulation of Sr the reverse is not true; only stimulatory effects upon K uptake were observed. Non-metabolic (physical) uptake of Sr comprises a large fraction of the total. This fraction is relatively insensitive to K. Calcium interferes much less than K with Sr uptake. The effects of K and Ca on the uptake and distribution of Sr and Cs in whole corn plants have been investigated. The inhibitory effect of K upon uptake of Sr by excised roots applies equally to whole plants. However, this inhibition of Sr uptake is accompanied by a relatively greater transport of Sr from root to shoot. Strontium, metabolically absorbed by the corn root, is fairly labile and available for upward transport. Calcium, as in excised roots, inhibits total uptake slightly but significantly increases retention by the root. Uptake of carrier-free ^{137}Cs by intact tomato leaf samples was found to be extremely variable. The variability appears to be related in large part to the age of the tissue. To counter this variability, an experimental procedure was adopted based on analysis of the ambient solution which permits uptake by a single sample to be observed over a lengthy experimental period. The results so far obtained have not demonstrated any involvement of a metabolically driven mechanism with Cs uptake. The amounts of ^{137}Cs taken up in ten hours at 0°C are essentially equal to those taken up at 26°C. The forms of the curves plotting uptake vs. time at the two temperatures are, however, greatly different. The rate of uptake at 0°C is constant over a 10-hour period. Uptake at 26°C is initially faster than at 0°C but the rate slackens after about four hours. Possible reasons for this are discussed. Urea, which has been shown to promote the absorption of phosphate and organic compounds in whole leaves, had an inhibitory effect on uptake of ^{137}Cs. The surfactant, Tween 20, stimulated ^{137}Cs absorption. The results of a 1971 field experiment on the effect of beta radiation on bush beans are reported. The beans were treated at three stages of growth with six levels of radioactive sand fused with ^{90}Y. The treatments ranged from 1.37 to 179.7 mCi/ft^2. Numerous TLD dosimeters were placed in plots. Irradiation with approximately 3,000 rads to the meristem severely reduced bean yields in young plants. At 20,000 rads, bean production was eliminated in all plants. Vegetative recovery effects were observed at intermediate levels of radiation. The results of a 1971 field experiment on the effect of beta radiation in barley plants are reported. The experimental design was similar to the bean experiment. In this experiment, grain yield reductions were observed, particularly when young plants received about 50,000 rads at the meristem. However, vegetative damage was visually quite noticeable where the plants received a dose of 8,000 rads to the meristem, but recovery mechanisms were of great importance in offsetting yield reductions. These recovery effects were only made possible by frequent and continued irrigation. The results of a 1972 experiment on the effect of beta reduction on pea plants are reported. The design of the experiment was similar to the preceding two, except that the plants were treated with ^{90}Y at a single stage of growth (bud to pre-bloom) with six levels of radioactive sand. Pea production was virtually eliminated when the meristems received approximately 4,000 rads and eliminated at higher levels. As previously found with other crops, the effect of radiation on edible crop yield occurred much in advance of the retardation of vegetative growth. The latter occurred at approximately 40,000 rads. Sealed-source ^{90}Sr$-^{90}$Y sources are currently being fabricated and installed in ten different beta exposure chambers. Each chamber will have approximately double the beta flux of the preceding chamber. These exposure chambers will be used to deliver constant rate exposures to plants in 8-in. pots; the plants then will be grown in a controlled environment to facilitate investigation of environmental stresses and recovery effects. (auth)

56574 CONDITIONS OF RADIUM ACCUMULATION BY PLANTS FROM THE SOIL. Vavilov, P. P.; Verkhovskaya, I. N.; Popova, O. N.; Kodaneva, R. P. pp 95-103 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The entry of radium into plants (bean, radish, sunflower, barley, spinach, salad) from soils with a high radium content (up to n. 10^{-7}%) was investigated. The basic factor, determining the rate and extent of radium absorption from the soil, is intensive growth associated with an increase in vegetation mass. The magnitude of radium transfer from the soil into the overground part of the plants is determined mainly by their biological productivity. Species differences in the relative radium content in the zone of the overground mass were as a rule small, no greater than one order in the plants investigated. The entry of radium from the soil continues during the entire active life of the plant. A slowing down of synthetic processes and rates of organ formations in plants has a limiting effect on the entry of radium. In leaves, the first period of life, associated with intensive increase in size, is characterized by a higher radium accumulation as compared with the period of stabilized leaf size. This fact proves that a relation exists between the age of the leaf and its radium accumulation. (auth)

56575 ACCUMULATION OF THORIUM, URANIUM, AND RADIUM BY PLANTS AND ORGANOGENEOUS HORIZONS OF SOILS. Gruzdev, B. I.; Rubtsov, D. M. pp 112-23 of Radioekologicheskie Issledovaniya v Prirodnykh Biogeotsenozakh. /Verkhovskaya, I. N. (ed.). Moscow; Izdatel'stvo Nauka (1972). (In Russian).

The accumulation and distribution of thorium, uranium, and radium in plants of the taiga zone was studied in relation to the content of radioelements in the soil. Only radium is accumulated by plants in substantial quantities; its biological accumulation coefficients are as a rule exceeding 1.0. It was found that the European mountain ash (Scorbus aucuparia L.) is possessed of a selective capacity of radium absorption, expressed in its high absolute content (up to n. 10^{-8}%) and characterized by a significant (up to 100) accumulation coefficient. Uranium and thorium accumulation coefficients are as a rule lower than 1, decreasing to 0.09 to 0.01 with a considerable increase of thorium in the soil. The study of the distribution of radioelements in plants showed that the greatest quantities of these elements concentrate in the older organs and tissues (bark, branches, wood) and the least in young ones (leaves, inflorescences). It is shown that radium, uranium, and thorium are elements with an acropetal distribution. The accumulation of thorium in forest litters follows the same trend as in the vegetative cover, that is no enrichment of the humus horizon with thorium is observed at a high content of this element in the soil. (auth)

New Tracer Techniques

Refer also to abstract 56391.

56576 USE OF TRITON X-100 FOR THE HIGH EFFICIENCY COUNTING OF PLASMATIC RADIOIRON BY LIQUID SCINTILLATION TECHNIQUES. Fillet, G. (Univ., Liege). Pathol.-Biol.; 20: No. 5, 227-30(Mar 1972). (In French).

An original method of measuring plasmatic ^{59}Fe using liquid scintillation techniques is presented. Using triton X-100 as an emulsifying agent and an operating temperature of 4°C, an efficiency of between 81 and 83% is regularly obtained; this value is five times greater than that obtained using solid scintillators. Without prior treatment, plasma volumes as large as 4 ml can be incorporated directly in the scintillator medium, and accurate counting effected. Decoloration processes and corrections for optical absorption processes are discussed. The method proposed can be used to measure the iron kinetics and erythropoiesis in man. (France)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 55696, 55899, 56302, 56313, 56641, 56659, 56680, 56714, 56722, 56735, 56741, 56785, 57964, 57965, 57968, 57973–57976, 57980, 58125, and 58368.

56577 (ANL–7920) CHEMICAL ENGINEERING DIVISION REACTOR SAFETY AND PHYSICAL PROPERTY STUDIES SEMI-ANNUAL REPORT, JANUARY–JUNE 1972. Chasanov, M. G.; Fischer, J.; Fredrickson, D. R.; Gabelnick, S. D.; Leibowitz, L.; Tevebaugh, A. D.; Vogel, R. C. (Argonne National Lab., Ill.). Aug 1972. Contract W-31-109-eng-38. 38p. Dep. NTIS.

Research progress is reported in the following areas: final results for the measurement of the enthalpy of Na_2O from 500 to 1300°K; matrix isolation studies of infrared spectra of species above $UO_{2\pm x}$; computer calculations of fission-product and fuel vapor pressures over mixed-oxide fuels up to 6000°K; a calculated P-V-T diagram for sodium; thermal diffusivity measurements for tungsten from 1870 to 3300°C and UO_2 at 1600°C; solubility data for UO_2 in molten basalt, and information on development of equipment to measure viscosities and densities of molten UO_2-basalt solutions. (auth)

56578 (BMI–1925) PROGRESS ON DEVELOPMENT OF FUELS AND TECHNOLOGY FOR ADVANCED REACTORS DURING JULY 1971 THROUGH JUNE 1972. Final Report, Task 6 and Task 7. Annual Report, In-Reactor Creep Program. Keller, Donald L. (Battelle Columbus Labs., Ohio). 30 Jun 1972. Contract W-7405-eng-92. 201p. Dep. NTIS.

Results of research on fuels are presented in three sections. A separate abstract was prepared for each section. (J.R.D.)

For abstracts of individual sections see: 56579–56581.

56579 (BMI–1925, Sect.A) URANIUM–PLUTONIUM NITRIDE FUELS FOR LMFBR APPLICATIONS. 30 Jun 1972. 56p.

In Progress on development of fuels and technology for advanced reactors during July 1971 through June 1972.

Research and development progress is reported on quality assurance for EBR-II fuel pin fabrication, preparation of EBR-II fuel pellets, preparation and in-pile surveillance of EBR-II fuel pin assembly, postirradiation evaluation of EBR-II fuel pins, and UN–PuN TREAT test operations. (J.R.D.)

56580 (BMI–1925, Sect.B) TECHNOLOGY OF NUCLEAR FUELS FOR ADVANCED FAST REACTORS. 30 Jun 1972. 58p.

In Progress on development of fuels and technology for advanced reactors during July 1971 through June 1972.

Research results are reported on irradiation behavior of oxide fuels at high temperatures. Data and information are included on clad UO_2 and UO_2-PuO_2 fuels irradiated at 1200 to 1900°C. (J.R.D.)

56581 (BMI–1925, Sect.C) CREEP OF REACTOR FUEL MATERIALS. 30 Jun 1972. 70p.

In Progress on development of fuels and technology for advanced reactors during July 1971 through June 1972.

Research progress is reported on design, fabrication, and operation of in-pile creep capsules for fuel testing. Results of investigations are reported on mechanical and thermal analyses of fuel creep specimens, in-pile creep of fuels, fabrication of oxide creep specimens, and mechanisms of creep. (J.R.D.)

56582 (CEA-CONF–2011) OBSERVATIONS OF MIXED IRRADIATED OXIDE WITH ADDITIONS OF FISSION PRODUCTS. Conte, M.; Mouchnino, M.; Schmitz, F. 1971. 38p. (In French). (CONF-720420–7). Dep. NTIS (U. S. Sales Only).

From Conference on reactor materials performance; Richland, WA. (24 Apr 1972).

Five elements—Mo, Ru, Ba, Zr, and Ce—representing fission products were incorporated in the mixed oxide $(U,Pu)O_2$. Short-time irradiation permitted the restructuring of the oxide and the equilibrium of the migration of the addition elements. After irradiation, the most marked observations made on these oxides were the absence of columnar structure in samples containing Mo, the enrichment in Pu, at the core, of some stoichiometric oxides, and the presence of a slug in the high parts of the central channel on pins containing Ru. The effects of the additions, O/U + Pu ratio, and the initial density on the thermal behavior of the pins and on the migration of U, Pu, and the fission and addition products are discussed. (tr-auth)

56583 (EURFNR–968, pp 115–25) SWELLING DUE TO SOLID FISSION PRODUCTS. Zimmermann, H.

Swelling rates due to solid fission products of 0.3 to 1.3%/% burnup were calculated for oxide fuel. The assumptions on which these values are based do not take account of fission product migration and release. It is suggested that a calculation be performed with an integral swelling rate of 0.7%/% burnup which as a first approximation and for lack of knowledge of the corresponding correlations can be regarded as independent of the temperature and burnup. If the fuel is divided up into different zones, the swelling rate in the high-temperature zone with columnar crystal formation should be reduced by the Cs fraction, namely, about 0.2%/% burnup, since the Cs largely vaporizes from this zone and is precipitated on cold surfaces. For carbide fuel, an integral solid swelling rate of 1%/% burnup is recommended. This value, which is at the lower limit of the calculated values, was adopted because density determinations on (U,Pu)C fuels with centerline temperatures of less than 1200°C always showed density reductions of $\leq$2%/% burnup. It can also be assumed that the swelling rates of various ceramic fuels behave approximately in the same way as their U and (U,Pu) densities. (auth)

56584 (EURFNR–968, pp 126–41) FISSION GAS BEHAVIOR IN THEORETICALLY DENSE FUEL. Matzke, Hj.; Ronchi, C.

The behavior of individual gas atoms in UO_2 or UC, which is important for the formation of bubbles and for their initial growth, is largely known, but it is unfortunately difficult to influence it. In the same way, the interactions between gas atoms and defects are largely researched, as is also the effect of the radiation-induced solubility of the fission gases. The older swelling theories must be modified in accordance with these findings. More up-to-date formulas are now being developed. Good agreement between the model and observation is at present being achieved at relatively low temperatures in particular. Further work is necessary in order to understand the correlation and the mutual effect of the microstructure and gas content, and in particular the effect of moving dislocation lines and grain boundaries. (auth)

56585 (EURFNR–968, pp 142–52) FISSION GAS BEHAVIOR IN POROUS FUEL. Zimmermann, H.

The quantities of fission gas released from oxide fuels under reactor operating conditions fluctuate considerably, especially at low and medium burnups. At burnups of around 100,000 MWd/t releases of 70 to 90% of the fission gas produced can be expected. The initial rise in the release rate with burnup is steeper in the case of vibratory compacted fuel than with pellets; generally speaking, it increases more steeply the higher the rod power and fuel temperature. The quantity of fission gas stored in the remaining sintering pores is small. At centerline temperatures of less than 900°C and for burnups of less than 5%, less than 1% of the fission gas produced in carbide fuels is released. Above 900°C and 5% burnup the release rises abruptly. (auth)

56586 (EURFNR–968, pp 153–64) MIGRATION OF FABRICATION PORES. Hoffmann, H.

In fuel rod model theory a distinction is made between the migration of fabrication pores and that of fission gas bubbles. Whereas the fabrication pores are formed during sintering (e.g., in the case of UO_2 at 1600°C and for a flowing mixture of hydrogen and inter gas), the fission gas bubbles are not produced in the reactor until burnup has advanced. The migration of fabrication pores is taken to describe short-time processes such as the formation of the central channel and the columnar grain zone, while the migration of fission gas bubbles covers longer processes such as fission gas release and swelling. An analysis of the behavior of sintering pores with an average gas pressure of 1 atm is presented. Information is included on pore migration, and migration velocity as a function of pore form. (J.R.D.)

56587 (EURFNR–968, pp 165–75) CREEP BEHAVIOR OF CERAMIC NUCLEAR FUELS UNDER NEUTRON IRRADIATION AT TEMPERATURES OF BELOW 1200°C. Brucklacher, D.

The experimental results available so far are not sufficient to permit an adequately precise description of the creep behavior of UO_2 under neutron irradiation. The correlations between creep rate and creep parameters must be investigated in greater detail. This is particularly true of the temperature dependence above 800°C, the porosity dependence in the range between 0 and 15 Vol.% porosity, the grain size dependence, the stoichiometry dependence, and all the creep parameters at higher burnups. No creep rates are known for UO_2/PuO_2. Creep data are particularly urgently required here. This also applies to UC and UN and to their mixed compounds. (auth)

56588 (EURFNR–968, pp 176–83) MECHANICAL PROPERTIES OF UNIRRADIATED OXIDE FUELS. Vollath, D.

The mechanical properties of unirradiated oxide fuels are discussed. The most suitable numerical values are selected from the extensive material available in the literature. Since the mechanical properties of sintered carbide and nitride nuclear fuels are at present very inadequately known, they have not been included in the report. Information is included on elastic properties, fracture behavior, plastic behavior, and creep behavior. (J.R.D.)

56589 (EURFNR–968, pp 210–19) THERMAL CONDUCTIVITY OF UNIRRADIATED CERAMIC NUCLEAR FUELS. Schmidt, H. E.

The aim of all the thermal conduction studies on nuclear fuels is to devise a means of calculating the temperature profile in a fuel rod and in particular of predicting the centerline temperature to be expected under given service conditions. As has already been indicated, such calculations are at present still very imprecise. The nature and extent of the problems still to be solved can be seen if the difficulty of calculating fuel temperatures at high rod power up to high burnups is compared with the present state of the art. The importance of the various effects, i.e., an order of priorities, can be determined by parameter studies. Research still to be conducted includes the measurement of the thermal conductivity of uranium dioxide and of uranium/plutonium mixed oxides of different stoichiometry up to very high temperatures; measurements to determine the influence which fission products exert on the thermal conductivity on simulated burnup samples up to very high temperatures, to be backed up by test measurements on real depleted fuel samples; a systematic study of the thermal conductivity of mixed carbides and nitrides as a function of their composition (C/M, N/M and O content and fission product concentrations) up to very high temperatures; and in-pile tests to verify the results obtained by individual measurements and model calculations. (auth)

56590 (EURFNR–968, pp 220–4) BURNUP DEPENDENCE OF THE THERMAL CONDUCTIVITY OF UO_2 AND $(U,Pu)O_2$. Schulz, B.

On the basis of results of simulation experiments and results of stoichiometry calculations a burnup dependence of the thermal conductivity due to stoichiometry shifts up to 1300°C can be assumed. Above 1300°C no numerical estimate of the change in the thermal conductivity with burnup is possible owing to the lack of experimental results. No experimental results are available for the carbides and nitrides. (auth)

56591 (EURFNR–968, pp 225–32) THERMAL EXPANSION OF OXIDE FUELS. Ondracek, G.; Kaempf, H.

Apart from high-temperature measurements on uranium dioxide, the maximum temperatures up to which coefficients of expansion for mixed oxides and plutonium dioxide are available at present are much too low. No results are available for the burnup dependence of the coefficient of thermal expansion. The results obtained so far do not permit any statement to be made concerning a correlation between the concentration and expansion in the mixed oxide. Since the values were in many cases obtained by radiography, confirmation of them by other methods such as mechanical or optical dilatometry would be desirable. It is noted that research is needed on extension of existing temperature functions for the coefficient of thermal expansion to high-temperature ranges, measurements of burnup dependence using simulated samples, methods of determining the correlation between thermal expansion and concentration in mixed oxides, and relations between thermal expansion and stoichiometry. (J.R.D.)

56592 (EURFNR–995) PREPARATION OF SULFUR-MODIFIED URANIUM CARBIDES. Korogiannakis, P.; Wedemeyer, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Translation of report KFK–1540. 41p. Dep. NTIS.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

With regard to a possible better compatibility behavior of nuclear carbide fuels containing uranium sulfide the preparation of uranium carbosulfides containing 1 to 4 wt % uranium monosulfide is described. A method for preparation of uranium oxysulfide from the reaction of uranium dioxide and carbon disulfide is described and the energy of activation of the reaction, q = 74.2 ± 0.5 kcal/mole, was determined. The carbothermic reduction of uranium oxysulfide to pure uranium monosulfide was found to be possible within the range of temperature of 1350 to 1400°C, above 1400°C the uranium oxysulfide slowly decomposes into uranium dioxide and uranium disulfide. The preparation of uranium carbosulfides by melting the pure components in an arc furnace under argon is easily realized. More propitious in technological fabrication seems to be the carbothermic reduction of uranium dioxide together with uranium oxysulfide. When taking pure UOS no reasonable result is obtained after short times of reduction (i.e., 5 h) in spite of the small amounts of oxysulfide in the mixture of reduction. However, when taking partially reduced uranium oxysulfide, uranium carbosulfide is obtained with impurities of oxygen of about 1000 ppM after times of reduction of 5 h at 1380°C and 3 h at 1850°C. (auth)

56593 (GEAP–12308) FISSION GAS RE-SOLUTION RATES. Quarterly Report No. 7, January 1–March 31, 1972. Marlowe, M. O. (General Electric Co., Pleasanton, Calif. Vallecitos Nuclear Center). May 1972. Contract AT(04-3)-189. 7p. Dep. NTIS.

Progress in an experimental program to determine the re-solution rates of fission gases in oxide nuclear fuels under irradiation is described. Specimens of irradiated UO_2 were annealed for confirmation of the choice of annealing conditions (1 hour at 1600°C) and the fission gas bubble size distributions so obtained. Preparation of those specimens for transmission electron microscopy is in progress. Additional specimens were also annealed for re-irradiation to determine quantitatively the effects of that second irradiation on the fission gas bubble size distribution. (auth)

56594 (GULF-GA-A–11075) REVIEW OF UZr-HYDRIDE DRIVER FUEL ELEMENTS FOR THERMIONIC REACTORS. Simnad, M. T. (Gulf General Atomic Co., San Diego, Calif.). 24 Jul 1972. Contract AT(04-3)-840. 56p. Dep. NTIS.

The feasibility of using uranium-zirconium-hydride fuel in driver fuel elements for the thermionic fuel experiment (TFE) is appraised. The results of the extensive irradiation tests and operational experience in the SNAP reactors and in TRIGA reactors are summarized. It is concluded that the UZr hydride fuels are suitable for use as driver fuels in the TFE. (auth)

56595 (JAPFNR–33) FABRICATION PROGRAM OF JOYO FUELS. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Translation of a Japanese report. 32p. (PNC-N–141-72-1-3). Dep. NTIS (U. S. Sales Only).

The pilot scale fabrication of Joyo fuels is described. Information is included on core pellet production process, fuel pin assembly fabrication process, and wet recovery process. Subsystems of the Pu fuel information system are described. (J.R.D.)

56596 (LAR–37) FUNDAMENTAL STUDY OF STABLE CERAMIC MATERIALS. Final Report, June 1960. Parker, H. S.; Hasko, S.; Rynders, G. F.; Schreyer, C. H.; Shapiro, H.; Foster, H. J.; DeLuca, S. T. (National Bureau of Standards, Washington, D. C.). Contract AT(33-3)-6. 134p. Dep. NTIS.

BERYLLIUM OXIDES—$BeO-ThO_2-UO_2$, thermodynamic properties of, conditions for mass spectrometric studies on
CALCIUM OXIDES—$CaO-UO_2-Y_2O_3-ZrO_2$, α activity, crystal structure, phase composition, and weight loss of, effects of heat treatments at 1400 to 1800°C on
CERAMIC MATERIALS—thermodynamic properties of fuel elements of, instruments and methods for studies of
CERIUM OXIDES—CeO_2-UO_2, α activity, crystal structure, phase composition, and weight loss of, effects of heat treatments at 1400 to 1800°C on
REACTOR FUEL ELEMENTS—thermodynamic properties of ceramic, instruments and methods for studies of
URANIUM OXIDES UO_2—oxidation to U_3O_7, effects of surface area on kinetic constants for
  —$UO_2-Y_2O_3$, α activity, crystal structure, phase composition, and weight loss of, effects of heat treatments at 1400 to 1800°C on
URANIUM OXIDES U_3O_8—thermodynamic properties of, conditions for mass spectrometric studies on
YTTRIUM OXIDES—thermodynamic properties of, conditions for mass spectrometric studies on
  —$UO_2-Y_2O_3$, thermodynamic properties of conditions for mass spectrometric studies on
  —$La_2O_3-UO_2-Y_2O_3$, α activity, crystal structure, phase composition, and weight loss of, effects of heat treatments at 1400 to 1800°C on
  —$Al_2O_3-UO_2-Y_2O_3$, α activity, crystal structure, phase composition, and weight loss of, effects of heat treatments at 1400 to 1800°C on
  —$UO_2-Y_2O_3-ZrO_2$, α activity, crystal structure, phase composition, and weight loss of, effects of heat treatments at 1400 to 1800°C on
ZIRCONIUM OXIDES—$La_2O_3-UO_2-ZrO_2$, α activity, crystal structure, phase composition, and weight loss of, effects of heat treatments at 1400 to 1800°C on (R.C.K.)

56597 (ORO–4212-12) QUANTITATIVE DETERMINATION OF THE STRUCTURE: PROPERTY RELATIONSHIPS IN NUCLEAR FUEL ELEMENT MATERIALS. Quarterly Progress Report, March 16, 1972–June 15, 1972. Rhines, F. N.; DeHoff, R. T.; Whitney, E. D. (Florida Univ., Gainesville. Engineering and Industrial Experiment Station). Aug 1972. Contract AT-(40-1)-4212. 46p. Dep. NTIS.

Creep studies of sintered nickel have advanced to the stage where it is necessary to separate contributions of creep and sintering to overall shrinkage. In order to determine the contribution of sintering to dimensional changes in creep specimens, density-time curves under zero load have been determined. Additional nickel creep data have been successfully modeled by a simple relationship between creep rate and time under load. The reduction of the data to a description in terms of three empirical constants will make tractable correlations between structure, load, and temperature which might otherwise defy reduction from the raw data. Isothermal and isochromal series have been prepared by pressure sintering UO_2 powders from three size fractions. Densification was characterized by dynamic shrinkage measurements at constant heating rate. Microstructural characterization in terms of the metric properties, volume fraction, surface area, and total curvature have been performed on pressure sintered UO_2 specimens. Paths of microstructural change for cold compacted and sintered, and pressure sintered UO_2 specimens were compared. In conventional sintering the path of microstructural change is determined by the compaction pressure. Recent results suggest that temperature may play a role in determining the path of microstructural change for pressure sintered UO_2 structures. Mechanical property measurements have been made on virtually all UO_2 specimens prepared to date. Fracture stress-volume fraction porosity data for specimens prepared by cold pressing and sintering were successfully modeled by a simple exponential relationship involving two empirical constants. Similar curves for pressure sintered UO_2 specimens showed definite maxima with strength dropping rapidly beyond the maximum in each case, presumably due to extensive grain growth. Thermal conductivity data was obtained for a broad range of UO_2 sintered microstructures. The data indicate that thermal conductivity is a function of the initial particle size of volume fractions of porosity up to 0.15. (auth)

56598 (RD/B/N–2402) ENHANCEMENT OF DIFFUSION CREEP UNDER IRRADIATION. Speight, M. V. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Aug 1972. 7p. Dep. NTIS (U. S. Sales Only).

A mechanism is proposed whereby the preference shown by dislocations for the absorption of radioinduced interstitials rather than vacancies influences the diffusion creep rate. The analysis demonstrated that the enhanced creep rate under irradiation has the same temperature dependence as the out-of-pile rate. This conclusion is in agreement with some previously reported experimental data on UO_2 (Perrin, 1971) and UO_2-PuO_2 (Perrin, 1972) in the temperature range 900 to 1200°C. (auth)

56599 (RT/MET–(71)3) PLASTICITY OF POLYCRYSTALLINE UO_2 AT HIGH TEMPERATURES. Ferro, C.; Ruggeri, F. (Comitato Nazionale per l'Energie Nucleare, Rome (Italy)). 20 Dec 1971. 30p. (In Italian). Dep. NTIS (U. S. Sales Only).

Sintered uranium dioxide specimens were subjected to compression tests at temperatures from 1,400 to 2,100°C. The creep behavior in the low stresses range could be represented by the relationship: $\epsilon = A \cdot \sigma^n \cdot \exp(-61600/RT)$ where $A = 1.5 \cdot 10^3$, $n = 0.53$ are constant of the material. (auth)

56600 (SGAE–2027) OPTICAL DETERMINATION OF ANISOTROPY OF PYROGRAPHITE. Koss, P.; Wallisch, K. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Metallurgie). Jul 1972. 10p. (In German). Dep. NTIS (U. S. Sales Only).

The irradiation behavior of pyrocarbon coated fuel particles is critically dependent on the anisotropy of the coating. A method for determining the anisotropy, based on the optical anisotropy of graphite single crystals, is described. The ratio of the reflectivities of a pyrocarbon section for polarized light with the E-vector parallel and perpendicular to the direction of preferred orientation is defined as optical anisotropy factor. Anisotropy profiles across the coating as well as irregularities can be determined by this technique. The theoretical and experimental basis and a fully automatic measuring equipment are described together with the results obtained. (auth)

56601 (SNE–101, App.B) PREPARATION AND CHARACTERIZATION OF NpO_2–CaO–ZrO_2 TARGET RODS FOR ^{238}Pu PRODUCTION IN COMMERCIAL WATER REACTORS. Kruger, O. L.; Pardue, W. M. (Battelle Columbus Labs., Ohio). Dec 1971. 86p. (BMI-X–626).

Two neptunia-zirconia-fueled target rods, each containing four sections of different neptunia concentrations, were fabricated and loaded into Connecticut Yankee Reactor for irradiation. Nominal compositions of the target pellets in the sections were 15.18, 28.06, 48.76, and 77.22 wt % NpO_2, with the balance of material being calcia-stabilized zirconia. Conventional ball-milling, cold-pressing, and sintering techniques were utilized for powder blending and pellet fabrication. Chemical analysis studies performed on selected pellets showed that total gas, moisture, and hydrogen contents were considerably less than specified tolerances. Metallographic examination revealed a uniform porosity and grain structure which indicated that the distribution of constituents was homogeneous. This fact was essentially confirmed by autoradiographic examination. Limited thermal expansion and thermal cycling tests were performed on various pellets to confirm their conformance to design specifications and resistance to fracture during irradiation. All work was conducted according to rigid pellet fabrication and weld specifications as well as stringent quality assurance procedures for each phase of the assembly operation. (auth)

56602 (UCRL-Trans–10642) BERYLLIUM BORIDE BeB_{12} WITH THE BETA-BORON STRUCTURE. Becher, H. J. Translated for Univ. of California, Lawrence Livermore Lab., Livermore, from Z. Anorg. Allg. Chem.; 306: No. 5-6, 266-72(1960). 11p. Dep. NTIS.

When rhombohedral γ-boron is heated with 4 to 12% of beryllium, the boride BeB_{12} is formed. When stoichiometric quantities of B and Be are used, the Debye–Scherrer diagram of this boride agrees with that of tetragonal β-boron. Any excess of γ-boron remains unchanged; a moderate excess of Be can be extracted with acids. The structure of BeB_{12} is described by an arrangement of B_{12} icosahedra as in β-boron, the beryllium atoms occupying half of the possible spaces between the icosahedra. (auth)

56603 PHASE REACTIONS IN THE SYSTEM CURIUM OXIDE + OXYGEN. Felmlee, T. L. (Univ. of Western Australia, Nedlands); Hyde, B. G.; Randall, C. H. J. Solid State Chem.; 5: No. 2, 286-90(Sep 1972).

The behavior of the system $CmO_x + O_2$ during isobaric thermogravimetric analysis is found to be different from that previously reported. The differences are discussed and explained as resulting from a higher sample purity. The earlier sample was contaminated by ~2.5% AmO_x which is believed to suppress the monotropic conversion of cubic $CmO_{1.5+\delta}$ to monoclinic Cm_2O_3. The hypothesis is consistent with other reports of the behavior of pure CmO_x, and explains some hitherto puzzling features of the earlier isobaric study. (auth)

56604 CRYSTAL CHEMISTRY AND SUBSOLIDUS PHASE RELATIONS IN THE SYSTEM Eu–W–O. McCarthy, Gregory J.; Fischer, Rose D.; Sanzgiri, Jyoti (Pennsylvania State Univ., University Park). J. Solid State Chem.; 5: No. 2, 200-6(Sep 1972).

Crystal chemistry and subsolidus phase relations in a portion of the system Eu–W–O were investigated. The stoichiometry and symmetry determined for compounds on the $Eu_2O_3-WO_3$ join are: Eu_6WO_{12}, cubic or tetragonal depending on the conditions of preparation—structure related to fluorite; $Eu_{14}W_4O_{33}$, pseudo-rhombohedral; Eu_2WO_6, monoclinic—structure related to scheelite; $Eu_2W_2O_9$, monoclinic—isostructural with $Pr_2W_2O_9$; $Eu_2W_3O_{12}$, monoclinic—structure also related to scheelite. The only divalent europium tungsten oxide, $EuWO_4$, had the tetragonal scheelite structure. Because of the structural similarity of $EuWO_4$ and $Eu_2W_3O_{12}$ ($Eu_{0.67}WO_4$), there was actually a limited scheelite structure solid solution Eu_xWO_4 ($x \approx 1 \rightarrow 0.77$) between them. A cubic europium tungsten bronze, Eu_xWO_3, was found for $x \approx 0.07 \rightarrow 0.15$. The compatibility relations among all of these phases and those on the Eu–O and W–O binary system are presented in a subsolidus phase diagram. (auth)

56605 MACHINING BORON-EPOXY COMPOSITES. Doran, Jay H.; Hanley, Fiske (General Dynamics Corp., Fort Worth, Tex.). Metals Eng. Quart.; 12: No. 3, 38-43(Aug 1972).

Cutting tool and machine tool parameters associated with the most commonly performed operations for machining composite materials, specifically B–epoxy composites, were studied. The results showed that diamond abrasive tools are required for cutting B–epoxy and multilayer B–epoxy/Ti. Impregnated tools should last longer than plated tools in most applications, and (despite higher initial cost) should result in lower overall expense for material removal. Use of cutting fluid is mandatory for B–epoxy/Ti machining, and is recommended for cutting B–epoxy. Single tool drilling of B–epoxy/Ti is feasible with extremely low feed rates and adequate flow of cutting fluid. Axial reciprocation of the diamond tool is required to produce good router cuts in B–epoxy/Ti. A boron machining handbook was published as a part of the program documentation. This handbook describes recommended cutting tools, machine tools, and procedures for performing common material removal operations. Quality control, safety, and equipment protection are also discussed. (P.C.H.)

56606 PROCEDURE FOR THE PRODUCTION OF METAL CERAMIC NUCLEAR FUEL. Gordon, E.; Fuhrman, N. (to

U. S. Atomic Energy Commission). German Patent 1,771,874. 24 Feb 1972. (In German).

A procedure is described for the production of dense uranium oxide–niobium cermets, the process being as follows: spherical UO_2 particles are first coated with wax and then with Nb powder, and compacted under isostatic pressure of at least 2,800 kg/cm^2, the wax being subsequently removed by heating the particles to 900°C in an inert atmosphere, upon which they are sintered at temperatures of 2,100 up to 2,300°C. The method is characterized in that base material consists of spherical UO_2 particles having a theoretical density of 55 to 70 percent and a diameter of 80 to 250 μ, as well as of 19.5 to 33.5 percent (by weight) of Nb particles, as related to the overall UO_2 amount, having a diameter of less than 10 μ. (GF)

56607 TITANIUM–BERYLLIUM COMPOSITES AND METHODS OF MAKING. Abkowitz, Stanley; Siergiej, John M.; Regan, Ronald D. (to Nuclear Components Inc.). U. S. Patent 3,681,037. 1 Aug 1972. Filed 21 Apr 1969.

Composites of titanium and beryllium are formed which have a high modulus of elasticity, low density and useful ductility. Titanium-beryllium composites in accordance with this invention comprise from 90 to 40% titanium and from 10 to 60% by volume beryllium. The composites are formed by consolidation of irregular shaped particles of titanium and beryllium under conditions which prevent alloying or compounding of the two metals. (Official Gazette)

56608 EFFECT OF THE CRYSTAL STRUCTURE ON THE ACID DISSOLUTION OF ZIRCONIUM OXIDE. Takeuchi, Takeji; Kawamura, Kazutaka (National Research Inst. for Metals, Tokyo). Trans. Jap. Inst. Metals; 13: No. 4, 262-4(Jul 1972).

Zirconia was dissolved in a nitric acid-hydrofluoric acid mixture. Relatively easy dissolution of low fired zirconia is considered to arise from a crystal structure different from the monoclinic zirconia. CaO-stabilized zirconia was prepared by a solid-state diffusion process and dissolved in the acid. The dissolution curves of cubic-monoclinic mixed phase zirconia consist of two parts; rapidly dissolving and slowly dissolving parts. The relation between the amount of rapidly dissolving phase and amount of CaO added coincides with the relation between the fraction of the cubic phase present and amount of CaO, so that it was concluded that the cubic phase of zirconium is to be very soluble. Tetragonal phase prepared by the addition of CeO_2 was also soluble. (auth)

56609 SYNTHESIS OF POLYCRYSTALLINE CUBIC BN. Wakatsuki, M.; Ichinose, K.; Aoki, T. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Mater. Res. Bull.; 7: No. 9, 999-1003(Sep 1972).

Polycrystalline cubic BN is obtained in a form of lump bodies by direct conversion from hexagonal BN at pressures of about 60 kbar. Density of this material is very close to the theoretical value. Its hardness, compressive strength, and chemical inertness at high temperature suggest that it is a promising material for cutting tools. Similar lump bodies are obtained also by sintering cubic BN powder. In this case, pressures to be applied in sintering can be much lower than those required for the conversion of hexagonal to cubic BN. These processes are successfully applied to cement powder of diamond into a compacted body. (auth)

56610 SEMI-INDUSTRIAL FABRICATION OF A HIGH TEMPERATURE HEATING ELEMENT FROM NIOBIUM CARBIDE. Avgustinik, A. I.; Ordan'yan, S. S.; Kudryasheva, L. V.; (and others) (Leningrad Tech. Inst.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 15: No. 6, 923-5(1972). (In Russian).

The technology for producing U-shaped heating elements from niobium carbide has been developed. As a binder for the powered niobium carbide, paraffin, wax, and oleic acid were added, which made possible nearly any radius of curvature at the bend of the U-shape. A rigid heating schedule, terminating at 1,100°C, is outlined for optimizing the properties of the finished element. The operating range of the product is 2,500 to 2,700°C. (K.S.W.)

56611 AXIAL THERMAL EXPANSION OF HfO_2. Stacy, Denzil W.; Johnstone, J. Keith; Wilder, D. R. (Ames Lab., Iowa). J. Amer. Ceram. Soc.; 55: No. 9, 482-3(Sep 1972).

The axial thermal expansion, volume thermal expansion and percent axial, and volume thermal expansions of monoclinic and tetragonal HfO_2 from 22 to 1940°C are given. (T.D.)

56612 PHASE BEHAVIOR IN THE Sm–B SYSTEM. Solovyev, G. I.; Spear, K. E. (Pennsylvania State Univ., University Park). J. Amer. Ceram. Soc.; 55: No. 9, 475-9(Sep 1972).

Phase equilibria in the samarium-boron system were investigated by X-ray and metallographic techniques. Melting behavior and temperatures, or limits for these temperatures, were determined and used in constructing a temperature-composition phase diagram. Four intermediate binary phases were found: SmB_x ($x = 2.0 \pm 0.6$), SmB_4, SmB_6, and SmB_{66}. The tetra- and hexaborides were well known, and phases isomorphous with SmB_{66} have been reported, but the SmB_x phase gives an X-ray diffraction pattern different from that of any known boride. Lattice constants were calculated for the 3 phases with known structures; the composition dependence of the values for the tetra- and hexaborides indicates that both phases have measurable composition ranges. Measured Vickers' microhardness values increase markedly for phases with increasing boron content. The SmB_x phase is very soft compared to most boride phases. (auth)

56613 METHOD OF MANUFACTURING MOLDS. Boncoeur, Marcel; Bredelet, Francois; Carpentier, Serge; Perrau, Daniel (to Commissariat a l'Energie Atomique). French Patent 2,092,913. 28 Jan 1972. Filed 30 Jun 1970. (In French).

A method of manufacturing molds for liquid metals (U or U alloys) is described. A mixture consisting of an aggregated refractory oxide and a bonding material (polymerizable when hot) is projected onto a shaping device a thin layer being formed; this shaping device is previously coated with a material facilitating its elimination when no longer required. The thin layer formed is allowed to harden at room temperature; it is then covered with a thick layer of consolidating material. The assembly is baked, the bonding material being eliminated by volatilization. The thin layer is composed of stabilized zirconia and the thick layer of a refractory concrete. (France)

56614 IMPROVEMENTS IN OR RELATING TO FORMING SPHERICAL BODIES BY PRESSING POWDER. Allsopp, Peter James (to United Kingdom Atomic Energy Authority). British Patent 1,278,254. 21 Jun 1972. Filed 19 Sep 1969.

A method of forming spherical bodies by pressing powder is to use a cylindrical die of diameter equal to that of the required spheres and top and bottom punches that are a sliding fit in the die and that have concave hemispherical working faces. This method results in the powder being compressed more at the periphery of the die than at its axis; with powders that flow readily this causes no problem, but with powders that do not flow readily, such as UO_2 mixed with a binder, after a certain stage of compression the rate of lateral displacement of the powder decreases with the axial load; and there is a likelihood of setting up zones of high stress around the periphery nearest the die wall, which may lead to splitting of the sphere when ejected from the die. In the method described, as the hemispherical working faces approach one another to form the spherical, body powder is allowed to flow from the two faces into a surrounding region and is progressively compressed within this region. The working faces may be suitably chamfered. (UK)

56615 IMPROVEMENTS IN OR RELATING TO METHODS OF VIBRATORY COMPACTION. Allsopp, Peter James (to United Kingdom Atomic Energy Authority). British Patent 1,278,255. 21 Jun 1972. Filed 19 Sep 1969.

Reference is made to methods of vibratory compaction, with particular reference to the production of reactor fuel elements in which the fuel is disposed annularly. It is known that in order to produce high-density bodies by the vibratory compaction of particulate material it is desirable to use particles of two or more different sizes, the smaller size particles being successively infiltrated into the previously compacted larger size particles. A method for annular reactor fuel elements embodying these principles is described. (UK)

56616 CERANOX-MATERIALS: PRODUCTION, PROPERTIES, AND APPLICATION. Nitzsche, H. G.; Fickel, A. (Annawerk GmbH, Roedental-Oeslau, Ger.). Tonind.-Ztg. Keram Rundsch.; 96: No. 1, 19-20(1972). (In German).

The production, properties, and uses of ceramic materials important to the nuclear industry are discussed. The materials include: aluminides, beryllides, borides, carbides, nitrides, oxynitrides, phosphides, selenides, silicides, and sulfides. (GF)

56617 HIGHLY CONDUCTIVE, TRANSPARENT FILMS OF SPUTTERED $In_{2-x}Sn_xO_{3-y}$. Fraser, D. B.; Cook, H. D. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Electrochem. Soc.; 119: No. 10, 1368-74(Oct 1972).

Highly conductive, transparent films of $In_{2-x}Sn_xO_{3-y}$ have been deposited by dc diode sputtering with Ar, O_2, N_2, Xe, and O_2–Ar mixtures. Sputtering targets with different In_2O_3/SnO_2 ratios were utilized and the best results were obtained with pure Ar or Xe gas and targets containing 9 to 13 mole percent SnO_2. The lowest film resistivity achieved was 1.77×10^{-4} ohm-cm, but routine films had resistivity values of about 3×10^{-4} ohm-cm. The use of a very low sputtering gas throughout ($10^{-2}-10^{-1}$ torr liter/sec) was found to be necessary to develop films with a slight oxygen deficiency. Targets differing in density (porosity) differ in their susceptibility to reduction so that sputtering conditions depend on target density. The films have excellent adherence and will tolerate cleaning, heating, polishing, and bonding without failure. They may be etched in heated acids with standard photoresist techniques used to define electrode geometry. Exposure of the films to temperatures of 500°C in air will cause an approximate factor of 3 increase in resistance at room temperature. Sputtered films with sheet resistance of 1.6 ohms/square, 73% light transmission, and 14% reflection at 500 nm have been obtained. Suitable antireflection coated films of 5 to 7 ohms/square possessing over 97% light transmission appear feasible. (auth)

56618 WARM-PRESSING METHOD OF MAKING STACKED FUEL PLATES. De Freitas, C. Trench; Handwerk, Joseph W. (to United States Atomic Energy Commission). U. S. Patent 3,668,285. 6 Jun 1972. Filed 27 Oct 1970.

A process is described for rapidly fabricating large numbers of thin, flat fuel plates of uranium dioxide or uranium dioxide-plutonium dioxide for use in a nuclear reactor. Using U_3O_8 or a uranium oxide having an oxygen to metal ratio greater than 2 to 1 as starting material, a plurality of such plates is pressed simultaneously in a metallic die at 800 to 1000°C in a reducing atmosphere using spacers between the plates. (Official Gazette)

56619 OBSERVATIONS OF KERNEL MIGRATION IN THE COATED FUEL PARTICLES UNDER TEMPERATURE-GRADIENT HEATING. Iwamoto, Kazumi; Kashimura, Satoru; Kikuchi, Akira (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 9: No. 8, 465-72(Aug 1972).

Several kinds of coated fuel particles, with their coating either intact or artificially cracked, were heated out-of-pile in such manner as to create a sharp temperature gradient across the particles (60 ~ 120°C per particle), at temperatures from 1,500 to 1,950°C. The purpose was to obtain information on the displacement of the kernel material relative to the coating. To examine this amoeba effect, the particles were observed, after heating, by both ceramography and x-ray radiography. The results revealed that: In the case of UO_2 kernel with artificially impaired coating, their kernels were found to move more readily toward the crack, regardless of the temperature gradient, as compared with UC_2. The amoeba effect is observed even in out-of-pile heating on intact coated particles with UO_2 kernel which moves down the temperature gradient. This UO_2 movement was given a new explanation based on the evaporation and subsequent condensation of the UO_2 within the particle, when the coating is intact. In case of UC_2 kernel, which moves up the temperature gradient, the sealing-in of the kernel by the intact coatings appears to assume a controlling factor, and the occurrence of evaporation is negligible. (auth)

56620 PROCESS FOR CARBURIZING THE METAL URANIUM AND THE URANIUM CONTAINED IN LOW-MELTING ALLOYS. Dolci, G.; Morselli, G. (to SNAM Progetti SpA). Canadian Patent 890,811. 18 Jan 1972. Priority date 24 Jan 1968, Italy.

A process is described for carburizing metallic uranium and the uranium contained in low-melting alloys to obtain uranium monocarbide and exclude high carburized products. The method is based on the use of a gaseous carburizing mixture (H_2 and CH_4) of a definite composition for every carburizing temperature. The carburizing gas is produced in a furnace containing carbon and its composition is adjusted by controlling the temperature of the furnace. Using this method, UC_2 or U_2C_3 can be decarburized by means of hydrogen with simultaneous formation of CH_4 which in turn carburizes metallic uranium to form the monocarbide. (Canada).

56621 COMPOSITE MATERIALS WITH FIBERS. Turpin, M. L. (Ecole Nationale Superieure des Mines de Paris, Corbeil, France). J. Cryst. Growth; 13-14: 97-105(May 1972). (In French).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

The development of composite materials involves the solution of a complex system involving many design parameters. A fairly large effort is still devoted to the development of B, SiC, and graphite continuous fibres to produce regular, high quality and low cost materials. Some examples of the problems encountered in the CVD growth of SiC and in the development of diffusion barriers on B for use in metal matrices at higher temperatures are given. The technology of composite fabrication with resin and metal matrices has progressed faster than the scientific understanding of the basic mechanisms. For instance, adhesion between C fibres and resin is low and techniques to improve it are developing slowly. For hot pressing with metal matrices tendencies are to use temperatures and pressures as low as possible. In situ solidification of eutectic is discussed at some length. Some systems show promise as high temperature materials for turbine blades, others are of interest for their physical properties. Characterization of the mechanical properties of composites is a difficult problem, but many data and excellent reviews are available. As the lack of toughness appears as a crucial problem, more work is necessary to understand the role of the interface on the fracture of composites. Presently, basic science is lagging in the technology, and effort must be continued in this field to improve the basic knowledge of the mechanisms and to guide actions in finding better combinations of composite properties. (auth)

56622 UNIDIRECTIONAL SOLIDIFICATION BEHAVIOR IN REFRACTORY OXIDE-METAL SYSTEMS. Chapman, A. T. (Georgia Inst. of Tech., Atlanta); Gerdes, R. J.; Wilson, J. C.; Clark, G. W. J. Cryst. Growth; 13-14: 765-71(May 1972).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

Eutectic growth has been observed in a number of refractory oxide−metal systems. During controlled solidification of UO_2-W mixtures, structures consisting of tungsten fibers uniformly embedded in the oxide matrix were formed. Tungsten fiber diameters between 0.3 and 1.0 μm and densities between 4 and 25 million per cm^2 have been obtained. Scanning electron micrographs of the various UO_2-W composite structures, after selective chemical etching to expose the metallic fibers, were used to analyze the structures. A preliminary interpretation of the solidification process leading to the different UO_2-W microstructures is presented using the starting oxide−metal ratio, a proposed phase diagram, and growth parameters. (auth)

56623 FINE-GRAINED COMPOSITE MATERIALS FOR SOK15M ELECTRICAL CONTACTS. Kornienko, V. P.; Kolesnikov, V. N.; Yudin, B. A. (Gorky State Univ., USSR). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 3, 240-4 (Mar 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 3, 90-6(Mar 1972).

Studies were made on the mechanism of codeposition and the nature of the resultant solid phases, thermolysis of the deposited products, the mechanism and kinetics of formation and interaction of the oxide and the metallic phase, and the relation between the nature of the forms being deposited and the type of distribution of the components in mixtures and finished parts, and the behavior of ultrafine Ag powders and their mixtures with oxides during pressing and sintering, and the relation between this behavior and the properties of parts in regard to the Ag + CdO mixtures. The results showed that the compacts produced under pressures of ≥ 7 tons/cm^2 from a hydroxide-deposited charge exhibited swelling owing to the appearance of closed pores. This phenomenon may be linked with the increased activity of such a charge, brought about by its formation, as a result of thermolysis, from a silver oxide base solid solution. (P.C.H.)

56624 SINGLE CRYSTALS OF REFRACTORY COMPOUNDS. PART I. Andrievskii, R. A.; Rymashevskii, G. A.; Sinel'nikova, V. S. Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 3, 207-15(Mar 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 3, 48-58(Mar 1972).

A state-of-the-art review is presented on the results of investigations into the preparation of single crystals of refractory compounds, including also some of the more important data yielded by studies on their structure and physicomechanical properties. The melting, diffusion impregnation, and deposition methods are considered in detail. The perfection (substructure and density of dislocations) of single crystals prepared by various methods and the role of powder metallurgy in the comparison of various methods of preparation of single crystals are also discussed. (65 references) (P.C.H.)

56625 ALUMINUM VAPORIZERS MADE OF MATERIALS BASED ON BORON NITRIDE AND TITANIUM DIBORIDE. Mogilenskii, V. I.; Gropyanov, V. M.; Zhunda, A. N.; Zeberin, A. G.; Egorova, G. V. (All-Union Inst. of Refractories, Moscow). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 3, 203-6 Mar 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 3, 42-7(Mar 1972).

Studies were made on the reactions of boron nitride with molten aluminum and the properties of $BN-TiB_2$ composite materials. On the basis of the results obtained, a process for the production of parts having the required characteristics was developed. On the basis of data yielded by thermodynamic, x-ray diffraction, metallographic, and chemical studies, it was established that, during hot pressing, boron nitride reacts with Al, resulting in the formation of aluminum nitride. However, materials based on $BN-TiB_2$ composites exhibited good corrosion resistance when exposed to molten Al owing to the formation of a protective surface layer of aluminum nitride. It was also found that the presence of 10% Al by volume improved the sinterability of $BN-TiB_2$ composites, enabling specimens of 4 to 5% porosity to be obtained from mixtures containing up to 50% boron nitride. The mechanical strength of all hot-pressed specimens was found to lie in the range 850 to 900 kg/cm^2. Finally an experimental batch of vaporizing elements of a standard industrial size was produced by machining blanks 200 mm in diameter and up to 60 mm high, hot pressed in a 500 kW, 100-ton press. (P.C.H.)

56626 MANUFACTURE OF HIGH-POROSITY MATERIALS FROM COMPLEX CARBIDES. Vitryanyuk, V. K.; Arbuzov, E. A. (Kiev Engineering Inst.). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 3, 216-19(Mar 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 3, 59-63(Mar 1972).

A study was made of the conditions of preparation of high-porosity materials from complex TiC−ZrC and TiC−NbC carbides during the actual simultaneous reduction and carbidization of oxides of the metals with carbon black in a vacuum. It was found that the process enables parts of 58 to 64 and 70 to 78% porosity to be produced from TiC−ZrC and TiC−NbC solid solutions, respectively, the resultant alloys having a satisfactory chemical composition and a fairly uniform pore size distribution. The $Me^{I}-Me^{II}$ bond was weaker in TiC−ZrC carbides, and because of this parts made from the former materials exhibited greater densification during sintering. (auth)

56627 REACTIONS IN THE METAL—OXIDE SYSTEM. Chernov, B. G. Izv. Akad. Nauk SSSR, Metal.; No. 2, 71-4 (1972). (In Russian).

A dependence could not be found between the thermodynamic stability of oxides (as judged by their free energy of formation) and their chemical resistance to attack by the molten metal. The relation of the reaction tendency on a metal−oxide system to the position and saturation of the valence shell of the oxygen atom in oxides is discussed. The oxides of elements with completely free (s- and p-elements) or incomplete (transition metals) d- and f-shells should be more soluble in metallic melts than stable oxides of the s- and p-elements. The oxides MgO, ThO_2, ZrO_2, HfO_2, and Y_2O_3 were quite reactive with the metals Nb and W at 1800 to 3000°C, in contrast to the lack of reactivity of BeO and Al_2O_3. (K.S.W.)

56628 COMPOSITION, STRUCTURE, AND MORPHOLOGY OF CERTAIN PHASES IN ALLOYS OF Nb—Zr—O AND Nb—Hf—O. Grigorovich, V. K.; Usikov, M. P.; Sheftel, E. N. Izv. Akad. Nauk SSSR, Metal.; No. 2, 198-200(1972). (In Russian).

Disintegration of the solid solutions Nb−1% Zr−O and Nb−(2 to 5%) Hf−O resulted in separation of the oxides ZrO_2 and HfO_2 with a monoclinic lattice. Both ZrO_2 and HfO_2 assumed the form of discs which lay in the $\{100\}$ planes of the Nb lattice. Plate diameters of the ZrO_2 increased from a maximum of 50 Å to 600 Å during the aging process; the thickness of the plates increased from a few atoms to about 60Å. (K.S.W.)

56629 ADDITION OF TANTALUM CARBIDE OR NIOBIUM CARBIDE TO WC—Co ALLOYS. Panov, V. S.; Meerson, G. A. Izv. Akad. Nauk SSSR, Metal.; No. 2, 181-4(1972). (In Russian).

The effects of TaC, NbC, or TaC + NbC on the properties of WC−13% Co alloy are studied. The introduction of 3 to 5% of either TaC or NbC hardened the alloy from 20 to 800°C, and increased its durability coefficient in turning cast iron. Its bending endurance and impact ductility were not significantly lowered at 20°C. (K.S.W.)

56630 NEW STUDIES ABOUT THE MISCIBILITY OF NITRIDES AND CARBIDES OF TRANSITION METALS. Kieffer, R. (Technische Hochschule, Vienna); Nowotny, H.; Ettmayer, P.; Dufek, G. Metall; 26: No. 7, 701-8(Jul 1972). (In German).

Forty 2-phase systems that are possible between the cubic carbides and nitrides of the 4a and 5a metals as nitride-carbide and nitride−nitride were reexamined. The samples were examined by x-ray and chemical analysis. In agreement with the 15% rule of Hume and Rothery, unbroken miscibility was found in the solid state between all carbide-nitride and nitride−nitride pairs with the exception of the pairs (ZrC, HfC)/VN, (ZrN, HfN)/VC, and (ZrN, HfN)/VN. The recently found cubic TaN also is uninterruptedly miscible with all carbides and nitrides of the 4a and 5a metals. (tr-auth)

56631 INFLUENCE OF HYDROGEN, CARBON, NITROGEN, AND OXYGEN ON THE PROPERTIES OF BERYLLIUM. Aldinger, F. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Metall; 26: No. 7, 711-19(Jul 1972). (In German).

Surveyed are available data on binary systems of beryllium with hydrogen, carbon, nitrogen, and oxygen, as well as on ternary systems of beryllium and gases. Constitution and thermodynamic data of mixed crystals and compounds are treated. Furthermore, the effects of the added elements are discussed with respect to equilibrium pressure, kinetics of gassing and degassing, and changes in mechanical properties. (tr-auth)

56632 SEALED CRUCIBLE TECHNIQUE FOR THERMAL ANALYSIS OF VOLATILE COMPOUNDS UP TO 2500^{0}C: MELTING POINTS OF EuO, EuS, EuSe, AND EuTe. Reed, T. B.; Fahey, R. E.; Strauss, A. J. (Massachusetts Inst. of Tech., Lexington). J. Cryst. Growth; 15: No. 3, 174-8(Aug 1972).

Thermal analysis and crystal growth are particularly difficult for compounds that have vapor pressures above a few torr or melting points above 2000°C. A technique utilizing welded refractory metal crucibles was developed for performing these operations. The metals tungsten, molybdenum, and rhenium are suitable for this technique, since they have melting points exceeding 2600°C, do not react with compounds of the more active metals, can be obtained in crucible form, are easily welded, and are relatively inexpensive. For thermal analysis, a crucible with a thermocouple well is mounted on a tungsten/tungsten (0.26 Re) thermocouple in a resistance-heated furnace, and the thermal arrest of the compound on melting or freezing is observed. The method was tested by measuring the melting point of Al_2O_3. The melting point, 2044 ± 5°C, agrees well with 2045 ± 6°C recently measured in a tungsten crucible. This method has been used to determine the previously unreported melting points of EuO, EuS, EuSe, and EuTe (1976, 2558, 2215, and 2183°C respectively), as well as those of several other compounds. (auth)

56633 HIGH-TEMPERATURE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF CERAMICS. Kiryutin, A. A.; Kiselev, N. P.; Kozitsyna, I. V. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 2, 265-7(Feb 1972).

Translated from Izmer. Tekh.; 15: No. 2, 51-2(Feb 1972).

A method is proposed which can be used for determining the thermal conductivity of electrically nonconducting materials at high temperatures (1500 to 3000°C). The specimens have the shape of cylindrical polyhedrons with an axial opening, in which the heater is placed. The temperature drop across two points on the outside surface is measured by means of photoelectric transistors. The thermal conductivity problem for the chosen specimen geometry is solved in the linear approximation. The maximum error caused by departure from the nonlinear boundary condition on the outside surface was estimated for the solution obtained. The working equation for the thermal conductivity coefficient allows for wide-range variations of the specimens dimensions and the experimental temperature. (auth)

56634 HYDROGEN-DISLOCATION INTERACTION IN NIOBIUM. Baker, C.; Birnbaum, H. K. (Univ. of Illinois, Urbana). Contract AT(11-1)-1198. Scr. Met.; 6: No. 9, 851-3(Sep 1972).

Measurements of the hydrogen cold work peak in Nb are presented which show that measurable binding energy between hydrogen and dislocations exists. (J.R.D.)

56635 INVESTIGATION OF OXYGEN ACTIVITY IN THE Ru—O AND In—O SYSTEMS BY GALVANIC CELL TECHNIQUES. Chatterji, Debajyoti. Lafayette, Ind.; Purdue Univ. (1972). 197p. University Microfilms Order No. 72-21,168.

Thesis.

The galvanic cell technique was applied to obtain thermodynamic properties of two industrially important high conductivity oxides, RuO_2 and In_2O_3. Results of the investigation were combined with data in the literature for a systematic thermodynamic analysis of the Ru−O and In−O systems. Electromotive force measurements on galvanic cells based on calcia-stabilized zirconia electrolytes allowed the determination of the free energy change for the reaction $RuO_2(s) + 4\ Cu(s) = 2\ Cu_2O(s) + Ru(s)$. The measurements were made over the temperature range 600 to 1000°C. The results were used to develop an equation for the standard molar free energy of formation of RuO_2: $\Delta G^0_{RuO_2} = -71{,}440 + 38.97\ T \pm 120$ cal/mole. The standard molar enthalpy and entropy of formation of RuO_2 at 298°K were calculated to be −72,430 ± 200 cal/mole and −40.44 ± 0.2 eu, respectively, using the above expression and the heat capacity data. The absolute entropy of RuO_2 at 298°K was calculated to be 15.46 ± 0.2 eu. The free energy data were also used to calculate the equilibrium oxygen pressure for the Ru−RuO_2 reaction over a wide temperature range. The free energy change for the reaction $2\ In(l) + 3\ NiO(s) = In_2O_3(s) + 3\ Ni(s)$ was determined by electromotive force measurements on suitable solid oxide based galvanic cells. In most experiments, calcia-stabilized zirconia was used as the electrolyte whereas yttria-doped thoria served as the electrolyte in some experiments. The measurements were made over the temperature range 550 to 800°C. The results indicated that calcia-stabilized zirconia remained ionic in nature even at the low oxygen pressures corresponding to the In−In_2O_3 equilibrium. The results were used to develop the following equation for the free energy of formation of In_2O_3: $\Delta G^0_{In_2O_3} = -215{,}550 + 72.63\ T \pm 450$ cal/mole. The standard molar enthalpy and entropy of formation of In_2O_3 at 298°K were calculated to be −213,580 ± 1500 cal/mole and −66.36 ± 0.5 eu, respectively, using heat capacity and enthalpy of fusion (for In) data. The absolute entropy of In_2O_3 at 298°K was calculated to be 34.90 ± 0.5 eu. The free energy data were also used to calculate the oxygen pressure for the $In-In_2O_3$ equilibrium over a wide temperature range. In_2O is the only stable gaseous oxide of In in the temperature range of interest. Combining experimental free energy of formation data for In_2O_3 with the free energy of formation for In_2O from the literature, partial pressures of O_2 and In_2O were calculated for a number of different experimental conditions. The usefulness of these calculations has been discussed. (Diss. Abstr. Int., B)

56636 RADIATION SWELLING OF CERTAIN TRANSITION METAL BORIDES. Guseva, T. M.; Gol'tsev, V. P.; Ol'khovikov, V. A. At. Energ. (USSR); 33: No. 3, 747-51(Sep 1972). (In Russian).

The results of radiation swelling studies of boron containing compositions subjected simultaneously to high temperature and neutron irradiation are given. Compositions based on chromium diboride and chromium plus titanium diborides were investigated. Specimens were irradiated in the SM-2 Reactor for ~230 days effective. The undisturbed flux of thermal neutrons was $5 \cdot 10^{14}$ $n/cm^2 \cdot s$ and of fast neutrons—$1 \cdot 10^{14}$ $n/cm^2 \cdot s$. It was shown that the material swelling is in fact consistent with the extent of porosity, which was determined by measuring the density before and after irradiation, and by means of structure metallography. The dependence of swelling and burnup of ^{10}B on specimen radius and the dependence of swelling on burnup are presented. Also presented are the results of temperature dependence studies of swelling. A complete scheme for radiation swelling has been plotted on the basis of the investigations performed. (auth)

56637 GAS-PHASE CHEMICAL DEPOSITION OF TITANIUM CARBIDE: EXPERIMENT AND EQUILIBRIUM CALCULATION. Reichle, Michael; Nickl, Julius J. (Univ., Munich). J. Less-Common Metals; 29: No. 3, 241-51(Nov 1972). (In German).

A study of the chemical vapor deposition ($TiCl_4$, CCl_4, H_2) of titanium carbide, TiC_x, on tantalum substrates has shown that titanium carbide, TiC_x, with a composition below x = 0.8 is not deposited even with a low mole ratio C/Ti(0.1) in the vapor phase. The results of a thermodynamical equilibrium computation of the system Ti−C−Cl−H have been compared with experimental values indicating that the chemical vapor deposition of titanium carbide is thermodynamically controlled. (auth)

56638 VAPOR DEPOSITION OF ZIRCONIUM CARBIDE-CARBON COMPOSITES BY THE CHLORIDE PROCESS. Ikawa, K. (Japan Atomic Energy Research Inst., Tokai). J. Less-Common Metals; 29: No. 3, 233-9(Nov 1972).

The conditions for the reaction of zirconium sponge (a) with methylene dichloride and (b) with chlorine in the deposition of zirconium carbide−carbon composites have been examined. Hydrogen must be present in the process involving methylene dichloride. In the chlorine process deposition is from zirconium tetrachloride, which is continuously generated by reaction of the sponge with chlorine and a hydrocarbon, methane being used in this work. Appreciable deposition of composite occurs above 1000°C in both processes. The mechanism of deposition is briefly discussed. (auth)

56639 X-RAY STRESS MEASUREMENTS AT THE CARBIDE PHASE OF TUNGSTEN CARBIDE-COBALT HARD METALS. Willbrand, Juergen (Fried. Krupp GmbH, Essen). Arch. Eisenhuettenw.; 43: No. 6, 503-8(Jun 1972). (In German).

X-ray stress measurements at the carbide phase of tungsten carbide−cobalt hard metals are described. The reflection dependence of the elongation rates in case of uniaxial compression testing and surface deformation by grinding are discussed. The radiographic elastic constants of tungsten carbide were determined. (auth)

Metals and Alloys

Corrosion and Erosion

Refer also to abstracts 56031, 58052, and 58126.

56640 (AERE-R-7001) MASS TRANSPORT OF STAINLESS STEEL CORROSION PRODUCTS IN FLOWING LIQUID SODIUM. Claxton, K. T.; Collier, J. G. (Atomic Energy Research Establishment, Harwell (England)). Mar 1972. 31p. Dep. NTIS (U. S. Sales Only).

The mass transport of corrosion products likely to be encountered in a fast reactor through exposure of stainless steel to flowing liquid sodium is being studied at A.E.R.E., Harwell. A pumped sodium loop capable of flow rates of 1100 kg hr^{-1} at temperatures of 600°C has been commissioned. This rig incorporates an indirectly heated active cylindrical test section and cold trapping and filtering facilities. It has been operated under conditions which simulate those obtaining in a single tube of the intermediate heat exchanger of PFR. The initial experiments have investigated the transport and deposition characteristics of ^{59}Fe, ^{54}Mn, and ^{60}Co. The ^{59}Fe behavior is characterized by its appearance as a firmly adherent deposit on pipework downstream of the test section. The effect of velocity, temperature gradients, and geometry have been examined. Physical methods of analysis including scanning electron microscopy, Auger spectroscopy, and the hitherto unused Cameca ion beam analyzer have been used to study the deposits formed. The behavior of ^{54}Mn is characterized by its rapid and highly preferential migration to the coldest part of the circuit, the diffusion cold trap. The first experiments with ^{60}Co have suggested that while the transport is similar to ^{59}Fe the deposit is less strongly attached and can be dislodged through velocity changes in the circuit. A decontamination procedure has been developed which seems to adequately remove the deposited activity. (auth)

56641 (EURFNR-968, pp 269-84) COMPATIBILITY OF CERAMIC FUELS WITH METALLIC CANNING MATERIALS. Goetzmann, O.

The compatibility of fuels such as UO_2 $(U,Pu)O_2$, UN, (U,Pu)N, UC, or (U,Pu)C with canning materials such as steel, nickel alloys, and vanadium alloys was studied. The compatibility includes chemical interactions between the can and fuel under operating conditions. Results are included on formation of new phases in the contact surface between the fuel and can, diffusion of fission products and metalloids (O,N,C) into the can, resulting in segregations in the can or its embrittlement, and diffusion of canning material components into the fuel, resulting in the weakening of the can and a change in the fuel (new phase, centering). (J.R.D.)

56642 (EURFNR-968, pp 285-302) SODIUM CORROSION OF CANNING MATERIALS. Borgstedt, H. U.

Corrosion mechanisms active between sodium and austenitic steels are discussed along with transport of interstitial elements in sodium during reactions with vanadium-base alloys. Corrosion mechanisms found in sodium reactions with other potential cladding materials are also discussed. (J.R.D.)

56643 (JAPFNR-25) MATERIAL WASTAGE TEST RESULTING FROM SMALL LEAK SODIUM WATER REACTION. Ueno, Masayuki; Sato, Yoshihiko; Sakurama, Naoki (Hitachi, Ltd., Tokyo (Japan)). Translation of a Japanese report. 50p. (PNC-J-202-71-11). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan).

In order to evaluate material wastage of tubes adjacent to a leaking tube in a sodium-heated steam generator, thirteen tests were made by injecting high-pressure and high-temperature water (140 kg/cm^2g 300°C) into stagnant sodium and examining wastage of $2\frac{1}{4}$ Cr−1 Mo steel targets. In addition, to obtain the basis of acoustic detection of small leak sodium-water reaction, spectra of reaction sound were analyzed. It was found that when the injection nozzle to the target spacing was 15 mm, maximum penetration rate, 0.025 mm/s, was obtained in the test of about 0.3 mm diameter injection nozzle; when the injection nozzle to the target spacing was 25 mm, the larger the injection nozzle diameter became, the more weight loss the target underwent; and as a result of spectrum analysis of reaction sound, the predominant frequency of reaction sound has been in the region of 1.7 to 1.8 kHz. (auth)

56644 (ORNL-TM-3972) RESULTS OF CORROSION EXPERIMENTS ASSOCIATED WITH SPENT LMFBR FUEL PROCESSING. Creek, G. E.; Griess, J. C. (Oak Ridge National Lab., Tenn.). Oct 1972. Contract W-7405-eng-26. 26p. Dep. NTIS.

Results of corrosion tests conducted under conditions that may exist during the chemical processing of spent LMFBR fuel elements are presented. In 8M HNO_3 dissolver solution a number of materials would be satisfactory but if fluoride is necessary for complete fuel dissolution, only tantalum appears to be suitable. In dilute dissolver solution at elevated temperatures, titanium and tantalum are acceptable. Zircaloy-2 is acceptable only in the absence of fluoride. In the system for scrubbing off-gases with nitric acid-mercuric nitrate solution, all of the austenitic stainless steels tested were acceptable. In the system where the off-gases are contacted with fumes from boiling 70% HNO_3, only Zircaloy-2, titanium, and tantalum proved to be satisfactory. Several materials were unaffected by extended contact with iodine crystals and/or saturated iodine solutions. (auth)

56645 (ZJE-121). CORROSION RESISTANCE OF THE SELECTED Zr ALLOYS WITH REGARD TO THE Zr 0.5 PERCENT Cu 0.5 PERCENT Mo ALLOYS. Mrkous, P.; Staif, M.; Benda, K.

(Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept.). 1972. 29p. Dep. NTIS (U. S. Sales Only).

Zr–0.8% Cu–0.8% Mo alloy corrosion tests were performed in carbon dioxide. From the oxidation kinetics and oxide compactness evaluations it followed that the changes, observed in the oxidation time dependences, correspond to the initial stage of a phenomenon denoted as the breakaway. The oxide layer was formed by monoclinic zirconium oxide. The dependence between the oxide thickness and weight increase was linear; in dependence on the oxidation temperature, 27 to 32% of oxygen of the overall weight increase (up to the time dependence change) was dissolved in the basic material. In the course of oxidation, carbon deposited on the oxide surface and then it diffused through the oxide layer and helped to damage it. Copper content in oxide was lower than in the basic material. Copper concentrated on the oxide-metal interface. (auth)

56646 CORROSION OF METALS UNDER COATINGS. Avgustinik, A. I.; Zhuravlev, G. I.; Matusov, I. A. J. Appl. Chem. USSR (Engl. Transl.); 45: No. 2, 413-15(Feb 1972).

Translated from Zh. Prikl. Khim.; 45: No. 2, 418-20(Feb 1972).

A method is described for evaluation of experimental data on corrosion of metals under coatings with protective layers, the thickness of which increases with time. It is possible by this method to find one of the quantities determining corrosion kinetics: the coefficient of ion diffusion through the coating, or the concentration of the adsorbed layer of corrosive agent at the interface between the coating and the corrosive medium. An example is given of the high-temperature oxidation of Mo with coatings based on the CrO_2 + CaO system with additions of Al_2O_3 and SiO_2. (auth)

56647 INTERACTION AND WETTABILITY IN THE URANIUM DIOXIDE–ZIRCONIUM SYSTEM. Ageenkov, A. T.; Bibikov, S. E.; Novoselov, G. P.; Savel'ev, V. F. At. Energ. (USSR); 32: No. 6, 490-1(Jun 1972). (In Russian).

Alloying of Zr with various metals, and the wettability of UO_2 by the resulting alloys were studied. The metals chosen for this study were Cu, Fe, Ni, and stainless steel. To a variable degree the alloys mentioned wetted UO_2. The chemical reaction $Zr + UO_2 = ZrO_2 + U$ did not occur to a noticeable degree in the temperature range 1,250 to 1,300°C. (K.S.W.)

56648 CORROSION OF METALLIC ZIRCONIUM IN MOLTEN ALKALI METAL CHLCRIDES SATURATED WITH HYDROGEN CHLORIDE. Krasil'nikova, N. A.; Smirnov, M. V.; Ozeryanaya, I. N.; Shamanova, N. D. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural. Filial; No. 15, 102-8(1970). (In Russian).

Corrosion of metallic Zr was studied in molten NaCl, KCl, and CsCl, saturated with dry hydrogen chloride, at 800 to 950°C. Introduction of HCl produces an approximately 20-fold increase in corrosion rate, due to oxidation by hydrogen ions. Elementary hydrogen is not liberated, but forms zirconium hydride. Stationary potentials were 0.1 V more positive than in pure chloride melts. Corrosion rates calculated from stationary potentials are in complete agreement with gravimetric values. 11 references. (Referativnyi Zh.)

56649 MICROCRACKS OBSERVED IN HYDROGENATED NIOBIUM FOIL. Amano, Muneyuki; Sasaki, Yasuo; Kainuma, Toshio (National Research Inst. for Metals, Tokyo). Trans. Jap. Inst. Metals; 13: No. 4, 296-7(Jul 1972).

A method of preparing Nb-H foils for use in electron microscopy is described. Thin foils of H-free Nb were prepared and then charged with H by the gas reaction method. In samples prepared by this method, microcracks were observed in the plates of brittle hydride on the foil. It is believed that these microcracks were initiated probably by the complicated elastic buckling of the foil due to many hydride plates. (J.R.D.)

56650 CORROSION RESISTANT Zr ALLOY. Armand, Marcel; Demars, Henri (to Ugine-Kuhlmann). French Patent 2,087,446. 6 Dec 1971. Filed 20 May 1970. (In French).

Corrosion resistant Zr alloys intended to be used for elements in contact with hot concentrated HCl and/or H_2SO_4 solutions containing oxidizing metallic ions such as Fe^{3+} are presented. These alloys contain between 0.5 and 4% by weight of Cu and less than 4.5% by weight of Hf. (France)

56651 SOME ASPECTS OF LOW-TEMPERATURE AND ANODIC OXIDATION OF METALS AND SEMICONDUCTORS. Vijh, Ashok K. (Hydro-Quebec Inst. of Research, Varennes). Oxidation Metals; 4: No. 2, 63-71(Jun 1972).

Recent ideas of Fehlner and Mott on low-temperature oxidation, both thermal and anodic, were examined with regard to the magnitudes of metal–metal and metal–oxygen bond strengths and their involvement in the interpretations of oxidation behavior of metals and semiconductors. It is pointed out that the magnitudes of bond strengths used by them appear to be inconsistent with the estimates of others based on well-established procedures. Some possible consequences of the reevaluated M–M and M–O bond strengths as regards the oxidation characteristics of metals are briefly mentioned. Also discussed is the influence of the estimated semiconductivity of anodization oxides on the subsequent anodic behavior of these metals. (17 references). (auth)

56652 REBUTTAL OF CRITIQUE OF "ON SOME ASPECTS OF LOW-TEMPERATURE AND ANODIC OXIDATION OF METALS AND SEMICONDUCTORS." Vijh, Ashok K. (Hydro-Quebec Inst. of Research, Varennes). Oxidation Metals; 4: No. 2, 79-83 (Jun 1972).

In rebuttal of the critique on the paper entitled "On Some Aspects of Low-Temperature and Anodic Oxidation of Metals and Semiconductors" various issues are examined under topics related to metal–metal bond strengths, metal–oxygen bond strengths, and semiconductivity of the oxide. (P.C.H.)

56653 CRITIQUE OF "ON SOME ASPECTS OF LOW TEMPERATURE AND ANODIC OXIDATION OF METALS AND SEMICONDUCTORS." Fehlner, F. P. (Corning Glass Works, Corning, N. Y.); Mott, N. F. Oxidation Metals; 4: No. 2, 75-8(Jun 1972).

The comments of Vijh on the paper, "Low-Temperature Oxidation," treat three separate topics: metal-metal bond strengths, metal-oxide bond strengths, and semiconductivity of oxides. A critique of these comments is given. (P.C.H.)

Preparation and Fabrication

Refer also to abstracts 55655, 55772, 55936, 56030, 56620, and 57968.

56654 (JAPFNR–34) FABRICATION ON "JOYO" BLANKET FUEL ASSEMBLIES. (Sumitomo Electric Industries, Ltd., Osaka (Japan)). Translation of a Japanese report. 7p. (PNC-N-141-72-1-4). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan).

Data and information are included on quality control, inspection, fabrication schedule, and fabrication precedures for the Joyo Reactor fuel assemblies. (J.R.D.)

56655 (JAPFNR–44) TEST FABRICATION OF WRAPPER TUBE FOR FUEL SUBASSEMBLY OF JOYO AND MONJU. (Sumitomo Metal Industries Ltd., Osaka (Japan)). Translation of a Japanese report. 35p. (PNC-N-141-72-1-15). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan).

Fabrication and testing of Type 316 stainless steel fuel cladding tubes for Joyo and Monju reactors is described. Test results are presented as the basis for selection of seamless cold drawn material for use in fabrication of fuel cladding for Joyo. Additional research is proposed for Monju fuel element cladding. (J.R.D.)

56656 (MCW–1510) SEVEN YEARS OF URANIUM ALLOY DEVELOPMENT AT WELDON SPRING, 1959/1966. Fellows, John A. (Mallinckrodt Chemical Works, Weldon Spring, Mo. Uranium Div.). 29 Jul 1966. Contract W-14-108-eng-8. 41p. Dep. NTIS.

Declassified 25 Oct 1971.

Early experiences are described in fuel core production and irradiation which led to the need to discover a means of refining the grain size of beta-quenched uranium metal. Initial success with empirical choices of dilute alloy additions was followed by evidence that actual control was vested in the provision for a critical dispersion of sub-microscopic precipitates of such intermetallic compounds as U_6Fe, U_3Si, and UAl_2. Appropriate precipitation prior to beta-quenching was not only effective for conventional fuel core processing but offered the possibility of refinement of structures cooled from the gamma phase either as extrusions or as both heavy- and light-walled castings. Extensive investigation of the quaternary constitutional diagram of U–Fe–Si–Al with metallographic and electron probe techniques, defined mutual solid solubility limits between the elements and the compounds but revealed no major differences in compound makeup in comparing binary, ternary, and quaternary systems. X-ray diffraction techniques were improved and refined to disclose the existence of texture gradients in alloyed uranium fuel cores and the response of such gradients to refined methods of heat treatment. Mechanical and physical properties of diverse alloys were measured to examine the variation in strength and hardness with temperature in the hope of finding a correlation with behavior during in-pile irradiation. Isothermal dilatometric studies of phase transformation revealed the differences in mode of beta-to-alpha phase change at different alpha temperatures as influenced by the level and type of alloy addition. Comparisons of such TTT data with texture measurements and irradiation tests suggested that the ideal core structure would be achieved by transformation at the nose of the upper "C" of the TTT diagram. Transmission electron microscope studies disclosed the size and shape of initial precipitates and defined the modes of metallic flow during tension testing as influenced by temperature. Efforts to achieve thin-foil samples suitable for observation of dislocation motion under mechanical and thermal stress in the hope of gaining an understanding of cavitational swelling did not meet with success in the brief time available for this project. (64 references). (auth)

56657 (RDT-M-2-17-T(9-72)) PRECIPITATION HARDENING ALLOY BARS, FORGINGS, AND FORGING STOCK (ASTM A461 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Sep 1972. 9p. RSO.

A standard prescribing requirements for precipitation hardening alloy bars, forgings, and forging stock (ASTM A461 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

56658 (RDT-M-7-14-T(9-72)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY ROD (ASME SB-336 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Sep 1972. 8p. RSO.

A standard prescribing requirements for Ni–Mo–Cr rod (ASME SB-336 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

56659 TUNGSTEN NEWS, JULY 1972. Tungsten News; 1-18(Jul 1972).

Production, properties, and uses of tungsten and its compounds are reviewed. Data and information are included on tungsten metal, tungsten carbides, tungsten-base alloys, tungsten additions to alloys, recovery and processing of tungsten and tungsten compounds. 371 references are included. (J.R.D.)

56660 BERYLLIUM ON THE BRINK. Bryson, Frederick E. Mach. Design; 43: No. 25, 136-9(14 Oct 1971).

Beryllium is very stiff, has good thermal properties, is reasonably strong and resists fatigue. Its disadvantages, however, include brittleness, anisotropy, low machinability, low corrosion resistance in chloride, sulfate and fluoride ions, toxicity, and cost. Properties are being improved by controlling free Fe, Al, and oxide impurities in Be and controlling the powder size in powder metallurgy parts. Alloys of Be with Al have improved machinability but stiffness and maximum service temperature are reduced. (Metals Abstr.)

56661 FORMATION MECHANISM AND APPEARANCE OF FLUX INCLUSIONS IN HARD-SOLDERED JOINTS. Colbus, J.; Tine, Th. Metall; 26: No. 2, 101-9(Feb 1972). (In German).

The type and development of soldering porosity was studied with respect to inclusions of soldering media into hard solders. Results showed the following: all defects within the soldered joint were caused by inclusions of flux media; three basic types of inclusions could be distinguished: one appeared as spherical emulsion droplets that were completely surrounded by solder; the second one formed a film-like layer between raw material and solder; and the third represented cylinders bridging the space within the soldered joint. Methods for preventing these soldering defects were presented. (H.B.G.)

56662 INVESTIGATION OF TEST METHODS ON THIN SHEET WELDING OF ZIRCALOY IN NUCLEAR ENGINEERING. Ruge, J.; Eggers, H. Schweissen Schneiden; 24: No. 5, 187-8 (1972). (In German).

56663 METALLOGRAPHIC INVESTIGATIONS ON MOLYBDENUM SPRAY COATINGS. Kampmann, Christel; Kirner, Kuno (Abt. Werkstoffkunde, Gerlingen, Ger.). Prakt. Metallog.; 9: No. 7, 363-9(Jul 1972). (In German and English).

A description is given of the preparation of polished sections of plasma-sprayed molybdenum coatings and investigation of these layers in the as-sprayed condition and after annealing in hydrogen or high vacuum. Scanning electron micrographs proved useful in the investigation of a peculiarity at the boundary surface between the spray coating and the base metal. (auth)

56664 PREPARATION OF THE HIGH TEMPERATURE FORM OF CURIUM METAL. Baybarz, R. D.; Adair, H. L. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem.; 34: No. 10, 3127-30(Oct 1972).

The high-temperature form of curium metal was prepared by reduction of curium oxide with thorium metal and volatilizing the curium at 1650°C. The high-temperature form of curium metal is fcc with a lattice parameter of 5.039 ± 0.002 Å which gives a metallic radius of 1.78 Å and a metallic valence of +3.0. (auth)

56665 METHOD FOR BRAZING GRAPHITE AND OTHER REFRACTORY MATERIALS. Canonico, Domenic A.; Cole, Nancy C.; Houck, Clarence W. (to United States Atomic Energy Commission). U. S. Patent 3,673,038. 27 Jun 1972. Filed 14 Apr 1970.

A description is given of a class of titanium-vanadium-chromium alloys which are particularly useful in brazing graphite and other refractory materials to themselves and to each other, and to the resultant brazed composites. The refractory materials which can be joined by the brazing alloy are selected from such materials as: tungsten, molybdenum, tantalum, rhenium, niobium, their alloys, and graphite. (Official Gazette)

56666 PROCESS FOR PLATING URANIUM WITH METAL. Petit, George S.; Wright, Ralph R. (to United States Atomic Energy Commission). U. S. Patent 3,668,084. 6 Jun 1972. Filed 10 Jun 1970.

A process is described for providing a uranium metal article with a tenaciously adhering metal plating deposited from aqueous solution. Prior to plating, oxides and other contaminants are removed from the surface of the article. The article then is heated in vacuum under selected conditions to form thereon a very thin and highly protective oxide film which is non-wettable by water. The surface of the oxide-coated article is made wettable by water by contacting the article with a basic wetting solution. The resulting wettable, oxide-coated article is then electroplated with metal in an aqueous metal-plating bath. (Official Gazette)

56667 PROCESS FOR BRAZING ZIRCONIUM ALLOY ELEMENTS. McGregor, Gavin (to Westinghouse Canada Ltd.). U. S. Patent 3,680,201. 1 Aug 1972. Priority date 15 Feb 1968, Canada.

A method for joining a zirconium alloy spacer to a zirconium alloy tube by placing a quantity of beryllium at a point outside the joint between the tube and spacer and heating the tube and spacer to form a liquid eutectic with the zirconium alloy is described. (Official Gazette)

56668 DIFFUSION WELDING AND ITS APPLICATION: EXAMPLES FROM THE FIELD OF ATOMIC ENERGY. Lison, Rudolf. Schweissen Schneiden; 23: No. 8, 304-8(Aug 1971). (In German).

The mathematical theory of diffusion in metals and alloys is outoutlined. In order to facilitate the diffusion process the required temperature must be reached in a specific time and suitable contact pressure between the metallic surfaces is necessary. From these considerations various design characteristics of diffusion-welding equipment can be ascertained, e.g., the construction of the heating cartridge. Suitable surface preparation is necessary to remove the oxide layer, grease, and other impurities. The metallurgical background to Fe/Al interactions is discussed and the properties of Fe–Al intermetallic compounds are tabulated, and examples of diffusion joints are given. A device for diffusion welding three specimens simultaneously is described. Diffusion welding is used in nuclear and aerospace technology where new material combinations are required. (Metals Abstr.)

56669 TUNGSTEN NEWS, OCTOBER 1972. Tungsten News; 1-18(Oct 1972).

Developments in tungsten technology are reviewed. Data and information are included on tungsten metal, tungsten carbide and other hard tool materials, tungsten base alloys, tungsten as an alloying element, tungsten recovery and processing, and tungsten compounds other than carbides. (327 references) (J.R.D.)

56670 EFFECT OF SUBSTRATE TEMPERATURE AND REACTANT GAS PRESSURE ON THE CHEMICAL VAPOR DEPOSITION OF TUNGSTEN FILMS. Shim, H. S.; Byrne, J. G. (Univ. of Utah, Salt Lake City). J. Cryst. Growth; 13-14: 410-13(May 1972).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

The growth kinetics, crystal morphology, and mechanical behavior of chemically vapor deposited tungsten films are strongly affected by substrate temperature. Lower substrate temperatures resulted in vastly stronger and harder materials. For example, a temperature of 500°C resulted in material with a higher yield strength than did a temperature of 700°C. The difference amounted to 3000 psi at four test temperatures between 200 and 800°C. Deposition pressure had little effect on film strength or appearance. Pressures of 300 and 500 torr were evaluated for deposits made at 500°C. The main structural difference observed between films produced at the two substrate temperatures was that at 700°C the columnar grains grew straight through the film but at 500°C there was a "fanning out" or a distribution in growth directions through the film thickness. Scanning electron microscopy revealed that the individual tungsten crystals advance with four sided pyramids at the interface, similar in appearance to those found in the electrodeposition of copper single crystals. It was found that these pyramids become steeper and more irregular with increasing substrate temperature. The pyramids have {111} surfaces, and propagate by the advance of ledges up the {111} facets. An activation energy of 16 kcal/mole was determined for film growth, indicative of control by surface diffusion, adsorption, and desorption processes. (auth)

56671 MORPHOLOGICAL INVESTIGATION ON A VANADIUM PRODUCT OF THE MAGNESIOTHERMIC REDUCTION. Varhegyi, Gyozo; Fekete, Istvanne; Sandor, Istvan. Femip. Kut. Intez. Kozlem.; 10: 187-202(1971). (In Hungarian).

Morphological examinations of macroscopic and microscopic nature were carried out on a product obtained at magnesiothermic reduction of vanadium trichloride and on vanadium sponge obtained by processing this product. The examinations contributed to the better understanding of the reaction mechanism and earlier ideas on reaction mechanism could be made more accurate. Also, conditions more favorable for acceleration of the process and formation of large crystals could be established. Based on results of the examination, the existence of large crystals could be established. From the examination of chemical composition of the individual samples, important conclusions could be drawn on the further processing of the product of magnesiothermic reduction. (auth)

56672 SETTING UP BALANCE OF VANADIUM OF THE BAYER-CYCLE AND CONCLUSIONS DRAWN ON THE DISSOLUTION DEGREE OF VANADIUM. Klug, Otto; Gal, Vilmos; Molnar, Lajos. Femip. Kut. Intez. Kozlem; 10: 45-59(1971). (In Hungarian).

In the course of studying the questions of vanadium dissolution a vanadium balance was set up during a 4 month period. Both solid phase samples and liquid phase samples were used for preparing the balance. Relationships of V_2O_5 charged with bauxite, of dissolved V_2O_5, and of separated V_2O_5, as well as the alteration of vanadium level at individual points of the Bayer-cycle were studied. Measurements have shown that about 0.5 kg V_2O_5/ton alumina can be yielded from the system. Possibilities of increasing vanadium dissolution were also studied. Effects of oxidizing agents and the use of roasting methods were investigated. Results showed that merely the use of strong oxidizing agents improve dissolution slightly, other oxidizing agents are practically ineffective. With respect to roasting it could be stated that vanadium dissolution is significantly improved by roasting, and 80% of the vanadium content of the bauxite roasted at 700°C for two hours dissolved in the alumina liquor by digestion instead of the usual 30 to 40%. (auth)

56673 COMPOSITION OF DECOMPOSITION PRODUCTS IN SLAGS FROM THE SMELTING OF Cr, Ti, Nb, AND Zr ALLOYS. Rusakov, L. N.; Dubrovin, A. S.; Lyakishev, N. L. Izv. Akad. Nauk SSSR, Metal.; No. 2, 31-5(1972). (In Russian).

The composition of metallic particles in slags was studied where the slags were formed during the disintegration of lower oxides. An x-ray spectral microanalyzer of French make was used, and the pure elements Cr, Ti, Fe, Nb, Zr, and Si were chosen as standards. Slag samples were coated with Cu for the purpose of stabilizing the electron beam. The type and quantity of decomposition products was found to depend on the degree of reduction of oxides and the slag composition. (K.S.W.)

Properties, Structure, and Phase Studies

Refer also to abstracts 55909, 56597, 56616, 56622, 56627, 56628, 57936, 57944, 57947, 57955, 57969, 57970, and 58368.

56674 (BMI–1928) PROGRESS ON LMFBR CLADDING, STRUCTURAL, AND COMPONENT MATERIALS STUDIES DURING JULY 1971 THROUGH JUNE 1972. Final Report, Task 32. Keller, Donald L. (Battelle Columbus Labs., Ohio). Jul 1972. Contract W-7405-eng-92. 70p. Dep. NTIS.

Results of investigations are presented on the low-cycle fatigue behavior of Type 316 stainless steel and Incoloy 800. Data are included for stainless steel at 70 to 1200°F and for Incoloy 800 at 800 to 1400°F. (J.R.D.)

56675 (COO–1436-34) INTRINSIC DIFFUSION AND VACANCY WIND EFFECTS IN SILVER–CADMIUM ALLOYS. Iorio, N. R.; Dayananda, M. A.; Grace, R. E. (Purdue Univ., Lafayette, Ind.). 1 Aug 1972. 30p. Dep. NTIS.

Diffusion in the silver–cadmium system was investigated at 600°C with vapor-solid and solid–solid diffusion couples in the alpha phase for the determination of intrinsic diffusion coefficients, atomic mobilities, and interdiffusion coefficients. Intrinsic diffusion coefficients, D_{Cd} and D_{Ag}, determined experimentally, were compared with those predicted from the models of Darken, Manning, and Dayananda with the aid of tracer diffusion and thermodynamic data. The experimental coefficients for various alpha alloys were found to be higher than those evaluated from each of the three models. On the other hand, the experimental values of the ratio, D_{Cd}/D_{Ag}, were found to be in good agreement with the models of Manning and Dayananda where the vacancy wind effects on intrinsic diffusion were taken into account. Darken's relations were considered inadequate to interrelate tracer and intrinsic diffusion coefficients in the Ag–Cd system, since vacancy wind effects were found to be appreciable in this system. (auth)

56676 (COO–1440-23) INVESTIGATION OF MIXED CONDUCTION IN SOLID ELECTROLYTES. Final Report, December 1, 1964–June 30, 1972. Rapp, Robert A. (Ohio State Univ. Research Foundation, Columbus). 26 Jul 1972. Contract AT-(11-1)-1440. 58p. Dep. NTIS.

Developments are reported for studies on: diffusivity and solubility of O in liquid Sn and solid Ag and the diffusivity of O in solid Ni; mixed conduction in pure ThO_2, $ThO_2-Sm_2O_3$, and $ThO_2-La_2O_3$ solid solutions; and electric conductivity in pure and doped Dy_2O_3 and Gd_2O_3. (P.C.H.)

56677 (COO–2048-5) ROLE OF PLASTIC INSTABILITY IN THE TEMPERATURE TRANSITION IN TENSILE DUCTILITY IN RIMMED CARBON STEEL. Annual Report, Part I. Vanecko, Joseph M.; Spretnak, Joseph W. (Ohio State Univ. Research Foundation, Columbus). Jul 1972. Contract AT(11-1)-2048. 54p. Dep. NTIS.

The role of plastic instability in directions of pure shear in the temperature transition in tensile ductility in rimmed low carbon steel was studied. Sheet specimens were employed with widths of 0.0250 inch and thicknesses of 0.038 inch ($w/t = 6.58$). Fracture occurred by plastic instability throughout the transition region. Some relatively small amount of necking occurred before the onset of the instability, indicating a stress gradient is required to activate the instabilities. The cause of the transition is the loss of the ability to deform uniformly, which is manifested by the strain hardening exponent "n" approaching zero. This is also the basis of the strength transition in toughness, although the mechanism of reduction of "n" may be different. Secondary instabilities were observed in some test's pieces in a direction normal to the axis of the specimen, giving rise to the familiar "slant fracture." Corresponding instabilities could not be observed in torsion bars, probably because of the convective gas cooling in the testing arrangement. (auth)

56678 (COO–3084-10) COMBINED MACROSCOPIC AND MICROSCOPIC APPROACH TO THE FRACTURE OF METALS. Technical Progress Report, July 1971–June 1972. Gurland, J.; Burns, S.; Freund, L. B.; Rice, J. R. (Brown Univ., Providence, R. I. Div. of Engineering). Jul 1972. Contract AT(11-1)-3084. 15p. Dep. NTIS.

A comprehensive study of the hardness of carbon steels was completed. It was proven theoretically and confirmed experimentally that the Brinell hardness and the diamond pyramid hardness correlate only if the Brinell hardness is determined at a particular value of the ratio of indentation diameter and indenter diameter, and the hardness correlates with the uniaxial flow stress at a strain of 7.5%. The hardness of the carbon steels under study can be represented as a function of grain size and particle spacing by a relation of Hall–Petch form. The Hall–Petch relation also applies empirically to the fatigue life of a spheroidized tool steel, evaluated as a function of particle spacing, in the very limited ranges of spacing and stress investigated. The effects of grain size on the dynamic fracture toughness, K_{Id}, were measured on a mild steel. An order of magnitude decrease in grain size gave a 100°C decrease in the transition temperature. The analysis of the dynamics of crack propagation in double-cantilevered-beam specimens was attempted for loadings of constant force and constant bending moment. In related work, the energy release rate in an extending crack was derived in terms of the dynamic elastic field of the crack, for the purpose of obtaining an equation of motion of the crack tip. This, and the preceding analysis, contribute to the understanding of the variation of fracture work as a function of crack velocity. The theory of ductile fracture progressed in the direction of developing a criterion for fracture based on unstable flow localization, i.e., when further deformation can occur without increase in the applied true stresses. The theoretical analysis attempts to predict the stress-strain state where the softening of the material through the porosity increase by hole growth has become sufficient to balance the progressive hardening of the matrix. Theoretical studies of the crack tip initiation mechanisms and of creep rupture models are continuing. (auth)

56679 (COO–3161-6) THEORY OF PHASE SEPARATION IN LIQUID METAL ALLOYS: Li_xNa_{1-x}. Stroud, D. (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics. Ohio

State Univ., Columbus. Dept. of Physics). Aug 1972. Contract AT(11-1)-3161. 18p. Dep. NTIS.

The phase separation curves of liquid metal alloys may be obtained by a variational method which involves no free parameters. The scheme was applied to Li_xNa_{1-x} and yielded results in good qualitative agreement with experiment. (auth)

56680 (COO–3164-2) LOW-TEMPERATURE PHASE TRANSFORMATION IN THE VANADIUM–HYDROGEN SYSTEM. Wanagel, J.; Sass, S. L.; Batterman, B. W. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). Mar 1972. Contract AT(11-1)-3164. 10p. Dep. NTIS.

Electron microscope specimens containing β-vanadium hydride showed evidence for the occurrence of a low-temperature phase transformation. Upon cooling to a specific temperature in the range from 170 to 200°K additional ⅓ order reflections appeared which were found to come from different regions other than the β hydride domains. The ⅓ order reflections were consistent with $(10\bar{1})_{bct}$ planes of hydrogen atoms spaced $3d_{10\bar{1}}$ apart. (auth)

56681 (EURFNR–994) CREEP RUPTURE AND CREEP BEHAVIOR OF ALLOY X8CrNiMoNb 1616 IN DIFFERENT PRETREATMENT STATES. Boehm, H.; Schirra, M.; Solano, R.; Garcia, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Translation of report KFK–1512. 83p. Dep. NTIS.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

In order to study the influence of different thermomechanical treatments on the creep behavior and time-to-rupture of stainless steel X8 CrNiMoNb 1616 (DIN 1.4981) samples of five different pretreatments were investigated in the temperature range 600 to 800°C. Starting with solution treated material (as obtained from the manufacturers) it was found that annealing at 700 and 800°C (Treatment II and III, respectively) did not materially affect time-to-rupture. On the other hand time-to-rupture and creep behavior were greatly improved by 12% cold-work (Treatment IV) and by cold-work and annealing at 800°C (Treatment V). This improvement was preserved for temperatures up to 700°C and times $>10^4$ hours. The loss of ductility was relatively small. The main effect of treatments IV and V was strengthening of the matrix via cold-work, i.e., the yield point at high temperatures was raised. This is an important point to consider for designing fuel element cladding. For this purpose the most important creep data for pretreatments I to V are given for all test temperatures and a wide range of stresses. The metallographic investigations gave insight into crack formation, fracture, and changes in the grain structure. (auth)

56682 (IS-T–552) ELECTROTRANSPORT OF OXYGEN, NITROGEN, AND CARBON IN HAFNIUM. Sever, James Charles (Ames Lab., Iowa). Aug 1972. Contract W-7405-eng-82. 66p. Dep. NTIS.

Thesis.

The electrotransport of oxygen, nitrogen, and carbon in hafnium was studied in both the α and β phases. Values for the mobility diffusion coefficients and effective valence were determined. The activation energy, ΔH, and frequency factor, D_0, were calculated for oxygen, nitrogen, and carbon in β hafnium and for nitrogen in α hafnium. The data from the transport study were applied to a theoretical model which was used to predict the amount of purification for one half of a rod as a function of treatment time. Values were obtained for purification of a 0.25-cm diameter rod 16.5 and 12.7-cm long heated to 2000°C for 2.75 days and 5 days. These runs were used to determine the effectiveness of electrotransport in purification of hafnium. The transformation temperature of reactor-grade hafnium was determined to be a 1717 → 1730°C $\alpha \rightarrow \beta$. (auth)

56683 (JAPFNR–35) CREEP AND CREEP-RUPTURE TESTS ON FUEL CLADDING TUBES OF 2nd TEST FABRICATION FOR JOYO. (Kobe Steel Ltd. (Japan)). Translation of a Japanese report. 10p. (PNC-N-141-72-1-5). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan).

Type 316 stainless steel tubes were fabricated under the 1969 specification and used for the tube exchange between the U. S. and Japan and for the creep testing. Data are presented on creep-rupture under internal pressure and uniaxial tension. (J.R.D.)

56684 (JAPFNR–36) ELEVATED TEMPERATURE FATIGUE TESTS ON CLADDING MATERIAL FOR FAST BREEDER REACTOR FUEL. (Mitsubishi Atomic Power Industries, Inc., Omiya (Japan)). Translation of a Japanese report. 24p. (PNC-N-141-72-1-6). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan).

Studies of isothermal fatigue at several temperatures under thermal cycle conditions were conducted on cladding of 316 stainless steel. Results of the investigation showed that data on isothermal fatigue at temperatures above 600°C is inadequate as a basis for design. Thermal cycle fatigue strength data should be used primarily in fatigue analysis. The factors which dominate the thermal cycle fatigue strength are maximum temperature and temperature range. Curves for equivalent elastic stress amplitude (Se) vs rupture time (Nf) are included. (J.R.D.)

56685 (JAPFNR–37) THERMAL RATCHET TEST ON CLADDING MATERIAL FOR FAST BREEDER REACTOR FUEL. (Mitsubishi Atomic Power Industries, Inc., Omiya (Japan)). Translation of a Japanese report. 15p. (PNC-N-141-72-1-7). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan).

Cladding material will operate in LMFBR at temperatures up to 700°C under repeated stresses. Therefore in fuel element design, the fatigue strength of cladding must be considered. Cylindrical hollow specimens of AISI 316 type stainless steel (wall thickness 0.5 mm) were pressurized by N_2 gas, and cyclic thermal stress were in the tube wall, then, thermal ratchet strains were detected by a displacement measurement apparatus in which laser beams are used. Results are discussed and tabulated. (J.R.D.)

56686 (JAPFNR–48) TEST RESULTS OF CLAD TUBES EXCHANGED BETWEEN U.S. AND JAPAN. (Kobe Steel Ltd. (Japan)). Translation of a Japanese report. 24p. (PNC-N-141-72-1-19). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan).

Results of testing of Type 316 stainless steel fuel cladding tubes for JOYO reactor are reported. Data and information are included on tube chemical composition, mechanical properties, tube dimensions, and ultrasonic testing. (J.R.D.)

56687 (JPRS–56785) EFFECT OF BORON ON THE STRUCTURE AND CERTAIN PROPERTIES OF ELECTRON-BEAM-MELTED MOLYBDENUM. Chernov, V. S.; Busol, F. I.; Lapitskaya, V. N.; Nam, B. P.; Kreymerman, G I. Translated from Fiz. Metal. Metalloved.; 33: No. 5, 1008-18(1972). 13p. NTIS.

The influence of small quantities of boron (up to ~0.1 wt %) on the structure and certain mechanical properties of cast and deformed electron beam-melted molybdenum was studied. It was found that boron had a strong modifying influence on the macrostructure, microstructure, and substructure of the metal, and also facilitated refining of grain boundaries. Microalloying with boron led to a significant increase in the ductility of molybdenum, as well as its strength and recrystallization temperature. (auth)

56688 (JPRS–56794) METALLURGY OF ALLOYS AND HIGH TEMPERATURES. Translation of articles from Izv. Akad. Nauk SSSR, Metal.; No. 3, 162-5; 190-3; 206-23; 240-51; 263(1972). 62p. NTIS.

Studies on phase field boundaries in the system W–Ta–Ti at 1600°C, effects of Mo and W on the properties of Ni–Cr–Nb alloys, and kinetics of solid-phase reactions in the systems Ta–Be–Zr and Nb–Be–Zr are reported. (P.C.H.)

56689 (NAA-SR-Memo–4853) P–C–T STUDY OF THE NaK-78–HYDROGEN SYSTEM. Atkins, D. F. (Atomics International, Canoga Park, Calif.). 12 Jan 1960. Contract AT-11-1–Gen-8. 7p. Dep. NTIS.

Declassified 4 Nov 1971.

Results of pressure-composition-temperature studies of NaK-78 with small additions of hydrogen up to 0.58 wt % indicated that the hydrogen solubility in NaK-78 is about 500 ppM at 980°F. Above 500 ppM hydrogen, solid hydride began to precipitate out. The quantity of solid increased with increasing hydrogen content. Dissociation pressure isochores taken at 0.32 and 0.58 wt % hydrogen showed that the isothermal plateau was not horizontal but had a slight slope. Therefore, two equations were derived to express the plateau pressures over the composition range studied. For alloys around 0.3 wt % hydrogen $\text{Log P (atm)} = 4.66 - [5050/T(°K)]$. In the vicinity of 0.5 wt % hydrogen, the dissociation pressures are best expressed by a slightly different equation: $\text{Log P (atm)} = 4.76 - [5050/T(°K)]$. The low dissociation pressures of the NaK-hydrogen compositions may indicate that the measured pressures represented the dissociation pressure of potassium hydride. The present studies were not sufficient to confirm this, however. (auth)

56690 (ORNL-TM–3602) CURRENTLY RECOMMENDED CONSTITUTIVE EQUATIONS FOR INELASTIC DESIGN ANALYSIS OF FFTF COMPONENTS. Pugh, C. E.; Liu, K. C.; Corum, J. M.; Greenstreet, W. L. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 114p. Dep. NTIS.

Constitutive equations are presented to describe the inelastic behavior of solution-treated Types 304 and 316 stainless steel and 20% cold-worked Type 316 stainless steel. The equations are for use by the Fast Flux Test Facility (FFTF) Project for inelastic design analyses of reactor components. The equations are recommended for interim use and the underlying reasons for their selection are given. Detailed mathematical relations which are necessary for use in design analyses are derived and recorded. Equations are presented in multiaxial forms for describing time-independent elastic-plastic behavior and time-dependent creep behavior. Because suitable formulations for coupling creep and plasticity on a sound basis do not now exist and because material behavior information concerning creep-plasticity interactions are lacking, the recommended mathematical descriptions for creep and plasticity are formulated independently. However, procedures are included which partially take into account the effects of prior creep on subsequent cyclic elastic-plastic behavior by recognizing that creep strains can have much the same hardening effects as do prior plastic strains. With regards to both elastic-plastic and creep behavior, specific attention is given to the applicability of constitutive equations to cyclic loading conditions. Cognizance is also maintained of the fact that the recommended procedures must be compatible with existing analytical capabilities. To support features of the recommendations, both sample analytical problems and results from special experimental tests are shown. (auth)

56691 (ORNL-TM-3894) PROCEDURE FOR DETERMINING BOUNDING VALUES ON FRACTURE TOUGHNESS K_{Ic} AT ANY TEMPERATURE. Witt, F. J.; Mager, T. R. (Oak Ridge National Lab., Tenn.). Oct 1972. Contract W-7405-eng-26. 27p. Dep. NTIS.

With the increasing need to insure quantitative margins of safety in structures which might contain flaws, it is becoming necessary to demonstrate more than just that fracture toughness K_{Ic} is high or unobtainable because of insufficient thickness of the particular product forms of interest for determining K_{Ic}. This problem comes particularly to the fore when attempting to determine K_{Ic} for irradiated water reactor pressure vessel steels such as ASTM A 533, grade B, class 1 plate steel. Here the problems of reactor space, fluence gradients, gamma heating and economics for large fracture toughness specimens tend to limit the size of specimens, to limit the number of such specimens which can be irradiated and to confound the final results. A method using compact tension specimens is proposed for determining upper and lower bounds on the fracture toughness of a material at any temperature of interest. First, the existence of K_{Ic} at all temperatures is explored. Using the equivalent energy approach to fracture the formulation of the bounding value equations is set forth and discussed. Lastly, bounds on K_{Ic} for ASTM A 533, grade B, class 1 steel are presented from temperatures above which valid K_{Ic}'s cannot be determined to 550°F. (auth)

56692 (ORO-3604-8) DETERMINATION OF DENSITIES OF ALKALI METALS BY A GAMMA RADIATION ATTENUATION TECHNIQUE. Final Report, January 1, 1967–December 31, 1971. Dillon, I. G.; LeVert, F. E.; Loretan, P. A.; (and others) (Tuskegee Inst., Ala. School of Engineering). 31 Mar 1972. Contract AT(40-1)-3604. 34p. Dep. NTIS.

Equipment was designed, constructed, installed, tested and used to demonstrate the radiation attenuation technique. The technique was used to obtain density data on cesium and lithium. Data were obtained up to 1053°K on cesium and to 2094°K on lithium. (auth)

56693 (RFP-Trans-111) STUDY BY THE MOESSBAUER EFFECT OF THE PRECIPITATION OF IRON IN BERYLLIUM. Janot, Christian; Gibert, Huguette. Translated for Dow Chemical Co., Rocky Flats Div., from Mater. Sci. Eng.; 10: 23-31(1972). 15p. Dep. NTIS.

An investigation was carried out on single crystals of Be, containing 1% by weight of iron, in a supersaturated solution, which was subjected to different thermal treatments causing the appearance of the ζ phase by precipitation of iron. Results obtained by means of the Moessbauer effect favor the hexagonal structure for $Be_{11}Fe$, and define the kinetics and the mechanism of precipitation. In the first stage, seeding and growth take place around dislocations with an activation energy, that of self diffusion of beryllium, and in the second stage, coalescence of the precipitate proceeds with an activation energy almost that of the diffusion of iron in the matrix. (auth)

56694 (SC-T-722548) KINETICS OF THE GAMMA-PHASE TRANSFORMATION IN U–Zr–Nb AND U–Nb–Mo ALLOYS. Gomozov, L. I.; Makhova, V. A.; Gomov, V. V.; Ivanov, O. S. Translated for Sandia Labs., Albuquerque, N. Mex., from Fiz. Metal. Metalloved.; 33: No. 2, 307-14(1972). 12p. Dep. NTIS.

The dependence of the gamma-phase isothermal transformation kinetics of U-base U-Zr-Nb and U-Nb-Mo alloys containing up to 15 at. % of components other than U was investigated at temperatures above 500°C. Results show that the kinetics of isothermal transformation of the gamma phase in the upper range of the S-curves in these systems is governed in the early stages mainly by the degree of supercooling, and in the later stages by the difference in composition between the parent and forming phases. In the case of ternary U-Zr-Nb alloys, in which the composition of the forming $\gamma_{Zr\text{-}Nb}$ phase is relatively close to that of the parent phase, the disintegration proceeds homogeneously (according to the microstructure data), obeying a single kinetic law, with n = 1 to 2.2, and it increases with rising temperature. The disintegration of a U-Zr alloy does proceed homogeneously but in two stages, because the respective compositions of the UZr_2 phase and parent gamma phase are far apart. In U-Nb-Mo alloys disintegration starts along the grain boundaries, i.e., proceeds heterogeneously. The fusing of the regions of primary disintegration is reflected by the transition to a second stage on the kinetic curves, in which the composition of the separating gamma phase begins to approach the equilibrium composition. Diffusion control of the disintegration kinetics in this stage is characterized by n values of from 0.5 to 0.8. Alloys with a Zr/Nb at. % ratio of 3:1 disintegrate at 550° with formation of a stable Widmanstätten structure, and are distinguished by their maximal heat resistance in the heterogeneous state, which is apparently due to the fact that the parameters of the parent and forming gamma phases are equal. Attainment of the equilibrium composition of the forming gamma or delta phases does not, as a rule, mean cessation of volume changes (to within 5×10^{-3}%/h). (auth)

56695 ELEVATED TEMPERATURE DUCTILITY MINIMUM IN HASTELLOY ALLOY X. Arkoosh, M. A.; Fiore, N. F. (Univ. of Notre Dame, Ind.). Met. Trans.; 3: No. 8, 2235-40(Aug 1972).

In a critical temperature range, usually centered about 1400°F, most nickel-base superalloys exhibit a minimum in ductility. In this investigation, metallographic, x-ray, damping, and scanning electron micrography studies have been made on Hastelloy alloy X, a typical solid solution strengthened superalloy. All studies indicated that extensive carbide precipitation, which depletes the lattice of solid solution strengthening elements, occurs in this alloy during plastic deformation at elevated temperatures. On the low temperature side of the minimum, the matrix is strong enough to compel grain boundaries to shear in response to the applied stress, causing severe localized plastic flow and intergranular fracture, thus decreasing the apparent total ductility of the material. Above the minimum ductility temperature, grain boundary shear is still occurring, but the matrix is so depleted in strengthening elements by precipitation that extensive intergranular flow occurs, causing an increase in ductility once again. (auth)

56696 EFFECTS OF STRESS COARSENING ON COHERENT PARTICLE STRENGTHENING. Tien, J. K.; Gamble, R. P. (Pratt and Whitney Aircraft, Middletown, Conn.). Met. Trans.; 3: No. 8, 2157-62(Aug 1972).

Studies were made on the effects of stress coarsening of coherent, $\gamma'[Ni_3(Al,X)]$ precipitates on the yield behavior of nickel-base superalloy single crystals. In so doing, the influence of coherent precipitate shape on yield strength, and the strengthening role of dislocation substructures in nickel-base superalloys was also determined. The γ' morphologies considered are large plates, long rods, and the familiar cuboids. These morphologies were obtained by annealing the crystals under applied tensile stress, applied compressive stress, and zero stress conditions, respectively. The ⟨100⟩ tensile test axes were perpendicular to to the γ' plates and parallel to the γ' rods. Between room temperature and 1400°F, the γ' rod and γ' plate morphologies were found to increase the yield strength of the crystals over that due to the γ' cuboids by about 10 ksi (10 pct) and 30 ksi (35 pct), respectively. Above 1400°F, the yield strengths of the crystals were found to be essentially independent of precipitate morphology. The increase in yield strength in going from crystals with γ' cuboids to those with γ' rods was found to be due to dislocation networks, which are produced as a natural consequence of annealing under stress. A simple analysis of the interaction between dislocations and the precipitates showed that the increase in yield strength in going from γ' rods to γ' plates is due to dislocation line tension and consistent with the difference in the shape of these coherent and ordered precipitates. The results of this investigation are comforting in that they show creep applications should not degrade the strength of nickel-base superalloy single crystals. The results are also discussed with respect to polycrystalline nickel-base superalloys and composite structures of γ and γ' phases. (auth)

56697 NIOBIUM BASED ALLOY. Kuhlmann, Ugine (to Societe des Forges et Ateliers du Creusot). French Patent 2,093,216. 28 Jan 1972. Filed 5 Jun 1970. (In French).

A new niobium alloy, preserving its mechanical characteristics at temperatures in excess of 1200°C, is presented. The alloy has approximately the same density as niobium and can be manufactured in an electron bombardment furnace. The alloy has a niobium base and contains between 0.1 and 5% by weight of Si or Ge, or Si + Ge, and 0.01 to 1% by weight of C. It also contains at least some W or Mo (less than or equal to 2%) and/or some Ta (less than or equal to 5%), the total quantity of these elements being less than 5%. (France)

56698 NEW INTERMETALLIC COMPOUND IN THE ZIRCONIUM–IRON SYSTEM. Babikova, Yu. F.; Filippov, V. P.; Shtan, I. I. At. Energ. (USSR); 32: No. 6, 484-5(Jun 1972). (In Russian).

Zirconium–iron alloys were studied with nuclear gamma resonance in the range 0.4 to 57 wt % Fe. Within the interval of compositions 0.4–24 wt % Fe the intermetallic compound Zr_2Fe was identified. The interval 25 to 55.15 wt % Fe included two compounds: Zr_2Fe and $ZrFe_2$. (K.S.W.)

56699 STABILITY AND DUCTILITY OF MOLYBDENUM IN SHORT-TERM TESTS. Severdenko, V. P.; Kal'nitskii, R. M. (Physical-Technical Inst., Minsk). Dokl. Akad. Nauk BSSR; 16: No. 4, 321-3(Apr 1972). (In Russian).

Toughness and ductility characteristics of metallo-ceramic, previously-deformed Mo were studied as a function of temperature in the interval 20 to 1,000°C as deformation rates 10^{-2} and 10^{-1} sec^{-1}. An index of the ductility was used as related to the linear form of the stressed state. Stretching of smooth and notched micro-specimens of Mo were compared. (tr-auth)

56700 INDUCED HIGH-PRESSURE PHASES IN THE Bi–In, Bi–Sn, AND Bi–Tl ALLOY SYSTEMS. Gordon, D. E. (Applied Research Lab., Fort Worth, Tex.); Deaton, B. C. Phys. Rev., B; 6: No. 8, 2982-4(15 Oct 1972).

High-pressure experiments on Bi–In, Bi–Sn, and Bi–Tl alloys are reported. X-ray diffraction and specific-volume discontinuities indicate that a new phase is formed in the Bi–In system under pressure at the composition of approximately 57 at. % bismuth. X-ray diffraction results show the new phage to be isostructural to the high-pressure phase BiSn formed at a pressure of 18 kbar at 23°C. The composition range of the ω phase formed in Bi–Tl alloys is extended toward the bismuth side under pressure. (auth)

56701 RELATION BETWEEN THE ENTROPY OF FUSION OR THE HEAT OF FUSION OF THE METALLIC ELEMENTS AND THEIR CRYSTAL STRUCTURE. Sawamura, Hiroshi (Kyoto Univ.). Trans. Jap. Inst. Metals; 13: No. 4, 225-30 (Jul 1972).

An investigation was carried out to revise the results of a previous investigation. For this purpose, the new data about the heat of fusion of most metallic elements have been used. It was found that the relation in question in metallic elements belonging to cp hex should be considered in two different regions separately, the one being the region of the lower melting temperature and the other the region of the higher melting temperature. The investigation revealed that the structures of the liquid phases in equilibrium with the solid metallic elements (except Al) belonging to fcc at their melting temperatures are the same regardless of the species of metallic element, because the relation between the entropy of fusion or the heat of fusion of these metallic elements and their melting temperature is represented exactly by a straight line or a smooth curve. The same thing can be said about the metallic elements belonging to other types of space lattice. Though the space lattice of the elements such as Zr, V, Ti, Mn, and Eu is considered to be bcc at present, most of them probably belong to fcc. Though the crystal structure of the elements such as Pa, Ac, U, Sm, Pm, Nd, Pr, La, Ce, and Ra is unknown at present, they probably belong to fcc or cp hex. (auth)

56702 THERMAL CONDUCTIVITIES OF LIQUID LEAD AND INDIUM. Duggin, M. J. (National Standards Lab., Sydney). J. Phys., F (London); 2: No. 3, 433-40(May 1972).

Thermal conductivity measurements were made on lead over the range 620 to 880°K and on indium over the range 520 to 845°K using a new apparatus of the axial flow type. In each case, the Lorenz number for the liquid metal falls steadily with increasing temperature. (auth)

56703 APPEARANCE OF THE CONTACT ZONES AND THE MECHANISM OF NORMAL ADHESION WITH SOFT METALS. Dayson, C.; Lowe, J. (National Research Council, Vancouver, B. C.). Wear; 21: 263-88(1972).

A series of experiments is described in which the normal adhesion between a steel ball pressed into flats of lead and indium was measured. The appearance of the contact zone, after the specimens had been separated, was closely examined and related to the experimental conditions and the measured adhesive forces. The occurrence of a "plucking up" or plastic flow effect at high adhesion conditions with freshly cut indium surfaces which was noted in a previous investigation has been confirmed. The restriction of this effect to an increasingly narrow band at the edge of the contact area, with an increasing degree of surface oxidation, has been demonstrated. Lead is shown to exhibit similar behavior. A mechanism involving the elasticity and plasticity of the softer metals is postulated which explains the varying width of the plucked up zone, and its relationship to the degree of oxidation of the surface and the ductility of the material. (auth)

56704 STUDY OF ADSORPTION AND NUCLEATION OF CADMIUM ON GERMANIUM SINGLE CRYSTALS BY A MOLECULAR BEAM TECHNIQUE. Voorhoeve, R. J. H.; Wagner, R. S.; Carides, J. N. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Cryst. Growth; 13-14: 167-73(May 1972).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

A molecular beam mass-spectrometric ultrahigh vacuum technique was used for the study of adsorption and nucleation of cadmium on the (111), (211), (110), and (331) faces of 45 Ω-cm germanium single crystals. Extensive cadmium adsorption preceded nucleation on all these faces. On the (111) face, two adsorption states, with heats of adsorption of 25 and 27 kcal/mole were identified, illustrating the barrier for nucleation of bulk cadmium which has a sublimation energy of 26.9 kcal/mole. The critical supersaturation for nucleation, α was found to be related to the atomic roughness of the germanium crystal face, the highest α being found on (111), the lowest on (110) and (331). No relation was found between the amount of preadsorbed cadmium and the critical supersaturation. This indicates that preadsorption fills adsorption traps in which cadmium atoms are immobile and unable to participate in statistical clustering. The effects of electrically active impurities on the nucleation has been investigated for the (111) faces of germanium crystals doped with gallium or arsenic. Both types of dopants enhanced nucleation, though only to a small extent. (auth)

56705 CONDENSATION OF INDIUM FILMS ON SILICON SUBSTRATES OBSERVED BY MASS SPECTROMETRIC TECHNIQUE. Nguyen Tan Tuan Anh; Cinti, R.; Chakraverty, B. K. (CNRS, Grenoble, France). J. Cryst. Growth; 13-14: 174-9(May 1972).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

The nucleation and condensation of indium on silicon substrate has been studied by a mass spectrometric technique. The method permits an exact and unambiguous measurement of the following important quantities: mean lifetime τ of an ad-atom of indium on silicon; the sticking as well as the thermal accommodation coefficient; the critical supersaturation for the onset of nucleation; the ad-atom population. It was found that both the sticking and the thermal accommodation coefficients are unity in the substrate temperature range. It was also found that, for a given substrate temperature, the mean lifetime τ is practically constant when the coverage θ is approximately lower than 0.1. When $0.1 < \theta < 1$, τ depends on the population n of adatoms and can be expressed by: $\tau = \tau_p \exp(-\alpha(T)n/kT)$, where $\alpha(T) \simeq 5 \times 10^{-16}$ eV/atom at 909°K and τ_p is coverage-independent mean lifetime, given by $\tau_p = 8 \times 10^{-13} \exp[(57,000 \pm 3000)/RT]$. An apparent undersaturation was observed; condensation begins when the equivalent pressure of impinging flux is still lower than the vapor pressure of the massive phase of indium. (auth)

56706 MONOVARIANT SOLIDIFICATION OF TERNARY ALLOYS: APPLICATION TO ZONE MELTING. Combrade, P.; Turpin, M. (Ecole Nationale Superieure des Mines de Paris, Corbeil, France). J. Cryst. Growth; 13-14: 751-6(May 1972). (In French).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

In studies on the unidirectional solidification of many-component two-phase alloys, a serious problem of segregation, which was investigated in the simple case of monovariant eutectics, was observed. A general formulation of the problem of the macrosegregation allows complete study of regular two phase growth, qualitative conclusion on irregular growth, and comparison between two techniques: solidification of a melt and zone melting. The most important result is that, in both cases, the compositions of the liquid bulk and of the growing solid do not follow the eutectic line. So it is shown, in good agreement with the experiments, that for the solidification of a melt the conditions required for regular growth are very difficult to obtain. However, zone melting which leads to a steady state whatever the diffusional flow, is particularly well suited for the growth of regular two phase composites. However, and in contradiction with a common point of view, the study of the evolution of the crystallization paths with the number of passes shows that this method is not suitable for determining monovariant eutectic lines in ternary alloys. These results can probably be extended to non-invariant eutectic reactions in n-component systems. (auth)

56707 RELATIONSHIP BETWEEN FINE STRUCTURE AND CRITICAL CURRENT DENSITY IN SUPERCONDUCTING BINARY TITANIUM–NIOBIUM ALLOYS. Rassmann, Guenther; Illgen, Lothar. Neue Huette; 17: No. 6, 321-8(Jun 1972). (In German).

The Ic-curve from 20 to 70 atomic percent niobium for the system titanium–niobium in the recrystallized, cold-formed, and heat-treated conditions is reported. The results are discussed with respect to fine structure. Impurities present in the Kroll-titanium stabilized the α-phase and, thereby, caused certain improvements in the Ic values. With a decreasing number of pinning centers resulting from elimination processes (meaning increased niobium content), the cold formation was enhanced to obtain optimal properties. Intermediate annealing increased Ic in the cases where no significant loss of solidity occurred. (tr-auth)

56708 REFRACTORY METALS AND ALLOYS. Gebhardt, E.; Fromm, E. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Werkstofftech.; 3: No. 4, 197-203(1972). (In German).

The application of refractory metals such as niobium, tantalum, molybdenum, tungsten, chromium and rhenium at high temperatures is discussed on the basis of a compilation of their physical, chemical, and technological properties. The present state of knowledge in this field indicates, that the high-temperature strength needed can be obtained with some of the refractory alloys at temperatures much higher than 1,000°C. However, at present, the oxidation resistance has not yet been improved enough to allow the use of these materials in air. (GF)

56709 THERMAL EXPANSION OF TWO-PHASE TEXTURIZED COMPOSITE MATERIALS. Kozlova, R. F.; Rabkin, V. B. Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 3, 234-9 (Mar 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 3, 82-9(Mar 1972).

Theoretical and experimental studies were made on the effects of temperature and composition on the thermal expansion of deformed (texturized) Mo–Cu two-phase composite materials, whose component phases differ markedly in their properties. The anisotropy of thermal expansion of such composite materials was investigated, and it was established that their volume expansion showed very little variation with deformation. It was demonstrated that two-phase composite materials can be formulated exhibiting thermal expansion characteristics controlled by their composition and the type and degree of plastic deformation. (auth)

56710 STRUCTURES OF $Y_2Zn_{\sim 9}$, $Gd_2Zn_{\sim 9}$, AND RELATED COMPOUNDS. Cromer, Don T.; Larson, Allen C. (Los Alamos Scientific Lab., N. Mex.). Acta Crystallogr., Sect. B; 28: No. 4, 1016-22(1972).

A number of $M_2X_{\sim 9}$ compounds exist where M is a rare earth or Pu atom and X is Zn or Cd. They all have a hexagonal cell, or subcell, with a about 14 to 15.5 Å and c/a about 0.98. Many of the compounds have a superlattice which increases the a axis and may or may not lower the symmetry. $Gd_2Zn_{\sim 9}$ is an ordered example of the parent structure. $Y_2Zn_{\sim 9}$ has an occupational disorder but does not have a superlattice. $Pu_2Zn_{\sim 9}$, $Y_2Cd_{\sim 9}$, and $Ce_2Cd_{\sim 9}$ each have different superlattices, but so far none of these superstructures has been solved. (auth)

56711 NEW APPLICATION POSSIBILITIES FOR TANTALUM. Feather, R. Metall; 26: No. 7, 753-4(Jul 1972). (In German).

Possibilities for the use of tantalum are summarized. Tantalum foil is used by the chemical industry in heating equipment, heat exchangers, and as plated tubing material. It also replaces stainless steel in sprinkler systems during production of explosives which use nitric acid and ammonia. The electronics industry uses considerable amounts of tantalum because of its superior physical properties, its gas absorption characteristics, and its electron emission. Other applications include high-temperature ovens, heat shields, air- and space travel, and surgical implantations. The nuclear industry, as well as the glass manufacturers, require great amounts of tantalum. At ultrahigh temperatures, tantalum should replace all metals with the exception of tungsten. The excellent ductility at low temperatures should create application possibilities as wire and sealing alloys. (H.B.G.)

56712 STUDIES ON VANADIUM-BASE ALLOYS. Jangg, G. (Technische Hochschule, Vienna); Kieffer, R.; Retelsdorf, H. J.; Prem, F. Metall; 26: No. 7, 720-6(Jul 1972). (In German).

It is suggested that coordinated developmental work will lead to improved materials with a vanadium base and that vanadium will increase in importance. Through addition of titanium and chromium, alloys are obtained which can be formed with good mechanical properties and, in part, with good corrosion resistance. Vanadium-titanium alloys with up to 10% chromium content can be rolled in the cold state and those with 40% chromium can be rolled in the warm state. These alloys also show good resistance against nitric acid and against alkaline media. (tr-auth)

56713 COMPOUNDS WITH A $MgCu_2$-TYPE STRUCTURE IN ALLOYS OF NICKEL WITH ZIRCONIUM AND HAFNIUM. Pet'kov, V. V.; Markiv, V. Ya.; Gorskii, V. V. Izv. Akad. Nauk SSSR, Metal.; No. 2, 188-92(1972). (In Russian).

Alloys which approximated the composition $ZrNi_2$ and $HfNi_2$ were studied by x-ray, metallographic, durometric, and differential thermal analyses. Both compounds resembled $MgCu_2$ in structure with the lattice constant a = 6.925 and 6.906 Å, respectively. The compound was formed by a peritectic reaction at 1190°C, and the compounds $ZrNi_5$ and $ZrNi_3$ were found at 1265 and 1575°C, respectively. (K.S.W.)

56714 REACTION OF HYDROGEN WITH THE RARE EARTH METALS AND YTTRIUM. Rodin, A. M.; Grushina, V. V. Izv. Akad. Nauk SSSR, Metal.; No. 2, 84-6(1972). (In Russian).

The reactions of H_2 with Er, Yb, Nd, Sm, Gd, Dy, Tm, and Y were investigated. Samples of Er and Yb had a purity of 99%; the other elements were >99.5% pure. The maximum quantity of H_2 absorbed by the given metals, and also their retention ability for H_2 were determined. Similar experiments were conducted with well-known H_2 sorbents such as Ti. Sm and Nd actively absorbed H_2 even at room temperature. The hydrides of Sm, Nd, Gd, Dy, and Y were unstable in air. The hydrides of Er, Tm, and Yb were stable in air. Rare earth metals saturated with H_2 lost a portion of the hydrogen upon heating until a ratio of nearly 2/1 had been established for H/Me. All rare earth metals tested retained significantly larger quantities of H at high temperatures than Ti. (K.S.W.)

56715 PHASE COMPOSITION DIAGRAM OF Mg–La–Ce. Rokhlin, L. L.; Bochvar, N. R. Izv. Akad. Nauk SSSR, Metal.; No. 2, 193-7(1972). (In Russian).

Alloys of the Mg–La–Ce system were investigated between 500 to 650°C with up to 30% La and 30% Ce using thermal and metallographic analyses. Projections of the surfaces of crystallization and liquidus and solidus isotherms were constructed. The electrical resistance of representative alloy samples was also measured. (K.S.W.)

56716 JOINT SOLUBILITIES OF TUNGSTEN AND CARBON IN NIOBIUM IN THE SOLID STATE. Popova, N. M.; Shamrai, F. I. Izv. Akad. Nauk SSSR, Metal.; No. 2, 185-7(1972). (In Russian).

The combined solubility of W and C in Nb was enhanced by an increase in temperature and decreased in accordance with the W content. The maximum solubility of C and W in Nb at 2,000 and 700°C was 1.9 and 0.9 at. %, respectively, and at 1,000°C was less than 0.35 at. %. (K.S.W.)

56717 MECHANICAL PROPERTIES OF ALLOYS BASED ON THE β-SOLID SOLUTION OF TITANIUM WITH 15.5 PERCENT Cr, ALLOYED WITH MOLYBDENUM, VANADIUM, NIOBIUM, AND TANTALUM. Mikheev, V. S.; Shnyrev, G. D. Izv. Akad. Nauk SSSR, Metal.; No. 2, 178-80(1972). (In Russian).

Mechanical properties of forged β-alloys of the system Ti + 15.5% Cr + (0 to 5)% Mo (or V, Nb, Ta) were investigated at room temperature. Limits of toughness, elongation, constriction, and impact ductility were established. Alloys with 1% Mo or V had greater limits of elongation, etc., than those with Nb or Ta. The Nb and Ta alloys, however, possessed greater ductility. (K.S.W.)

56718 COMPOUND La_2Ni_7 AND ITS CRYSTAL STRUCTURE. Bilonizhko, N. S. Izv. Akad. Nauk SSSR, Metal.; No. 2, 176-7(1972). (In Russian).

Samples of 99.8% La and 99.91% Ni were sealed in quartz ampules under vacuum, maintained at 800°C for 300 h, and chilled in cold water. X-ray analysis showed a single hexagonal phase corresponding to the formula La_2Ni_7, isostructural with Ce_2Ni_7, with a = 5.061 Å and c = 24.66 Å. (K.S.W.)

56719 PHASE COMPOSITION DIAGRAM OF Hf–Pd. Shurin, A. K.; Pet'kov, V. V. Izv. Akad. Nauk SSSR, Metal.; No. 2, 166-8(1972). (In Russian).

The melting point diagram of the Hf–Pd system is characterized by one eutectic (27% Pd, 1,325°C), one compound, $HfPd_2$ melting at 2,075°C, and four eutectoids: Hf_2Pd (1,415°C), HfPd (1,610°C), Hf_3Pd_4 (possibly Hf_2Pd_3, 1,560°C), and $HfPd_3$ (1,965°C). The solubility of Hf in Pd is about 22.5 at. %; and the solubility of Pd in Hf is only about 1 at. % in α-hafnium and less than 5 at. % in β-hafnium. (K.S.W.)

56720 SOFTENING OF HIGHLY DEFORMED MOLYBDENUM SINGLE CRYSTALS. Kopetskii, Ch. V.; Kulesko, G. I.; Ionov, A. M. Izv. Akad. Nauk SSSR, Metal.; No. 2, 130-5(1972). (In Russian).

The changes in Mo single crystals as a result of deformation by rolling in different orientations were studied by means of electron microscopy and the x-ray microbeam. Crystals rolled in the (100) ⟨110⟩ plane to 97% deformation achieved dislocation densities of 1×10^{11} cm^{-2}. In deformed crystals (110) ⟨110⟩, (88%), a porous structure was observed and the density of dislocations was 1×10^{11} cm^{-2}. The effects of subsequent annealing are also discussed. (K.S.W.)

56721 INVESTIGATION OF THERMODYNAMIC PROPERTIES OF THE ALLOYS La–Al AND La–Pb BY THE emf METHOD. Lebedev, V. A.; Kober, V. I.; Nichkov, I. F.; Raspopin, S. P.; Kalinovskii, A. A. Izv. Akad. Nauk SSSR, Metal.; No. 2, 91-5(1972). (In Russian).

The state of La in alloys with Al and Pb was studied in an Ar atmosphere in the interval 680 to 850°C by the emf method. The solubility and temperature dependence of the activity coefficient of La was measured in La–Pb and La–Al solutions. (K.S.W.)

56722 FUEL AND STRUCTURAL MATERIALS. Amaev, A. D.; Platonov, P. A. At. Energ. (USSR); 33: No. 2, 657-71 (Aug 1972). (In Russian).

A survey of foreign reports dealing with fuel and structural materials presented at the Fourth International Conference on Peaceful Uses of Atomic Energy, Geneva, 1971 is given. (tr-auth)

56723 PHASE DIAGRAM OF THE SYSTEM NEODYMIUM–DYSPROSIUM. Kobzenko, G. F.; Svechnikov, V. M.; Martinchuk, E. L. (Inst. of Metal Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 6, 563-5(1972). (In Russian).

Alloys cast at 800 and 550°C were studied by the methods of differential thermal, x-ray crystal, metallographic, and dilatometric analyses. The alloys were melted of compact neodymium (99.34%) and dysprosium (99.76%) in the arc furnace. Neodymium and dysprosium are established to dissolve considerably in each other and to form the compound Nd_xDy_y with the samarium-type structure. The alloys, depending on temperature and composition, can undergo three non-variant transformations which the reactions $L + \alpha_{Dy} \rightleftharpoons \beta_{Nd}$; $\beta_{Nd} + \alpha_{Dy} \rightleftharpoons \alpha_{Nd}$; $\alpha_{Nd} + \alpha_{Dy} \rightleftharpoons Nd_xDy_y$ correspond to. Phase diagram is plotted within a complete interval of temperatures and concentrations. (auth)

56724 PHASE EQUILIBRIA IN ALLOYS OF SILICON WITH MOLYBDENUM AND TITANIUM. Svechnikov, V. M.; Kocherzhins'kii, Yu. O.; Yupko, L. M. (Inst. of Metal Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 6, 566-70(1972). (In Russian).

The alloys of the system Mo–Si–Ti were investigated by the methods of differential thermal, x-ray, and metallographic analyses. The existence of wide regions of solid solutions on the base of silicides Mo_5Si_3 and Ti_5Si_3 was found in the system Mo_5Si_3–Ti_5Si_3. The boundaries of the two-phase region $Mo_5Si_3 + Ti_5Si_3$ at 1800°C run from 35 to 59 mole % Mo_5Si_3, at 1425°C they run from 30 to 59 mole % Mo_5Si_3. The isothermal section of the diagram $MoSi_2$–$TiSi_2$–Ti_5Si_3–Mo_5Si_3 was obtained at 1425 and 1600°C and the formation of three-element compound γ (20.5 to 22.5 at. % Mo, 32 to 33.75 at. % Ti, 45 to 46.1 at. % Si) was established. The complete melting diagram for the system $MoSi_2$–$TiSi_2$–Si is presented by the isothermal section at 1250°C, projections of the solidus and liquidus surfaces to the plane of a concentration triangle and by eight polythermal sections at the constant content of Si (from 40 to 80 wt % Si after each 5 wt %). (auth)

56725 POSSIBLE PROBLEM IN MEASURING HYDROGEN DIFFUSIVITY AT LOW TEMPERATURES BY THE GORSKY EFFECT. Westlake, D. G. (Argonne National Lab., Ill.). Scr. Met.; 6: No. 9, 887-90(Sep 1972).

The stress-induced precipitate reorientation effects on the activation energy for diffusion of H in Nb at temperatures below 273°K are discussed. Results of experiments in which tensile stress was imposed on niobium–hydrogen alloys causing formation of hydride platelets normal to the tensile direction are reported. These platelets rearranged in the opposite direction when the load was removed. These and other results are used to show that the presence of small volume fractions of NbH affects measured results of H diffusion in Nb as determined using the Gorsky effect. (J.R.D.)

56726 STRESS EQUIVALENCE OF SOLUTION HARDENING. Basinski, Z. S.; Foxall, R. A.; Pascual, R. (National Research Council of Canada, Ottawa). Scr. Met.; 6: No. 9, 807-14(Sep 1972).

Data on Cu-base, Ag-base, and Mg-base alloys are analyzed to show that the thermal behavior of solution hardening is dependent on stress but it does not depend directly on the concentration of solute, and that the activation volume involved in such reactions may contain a large number of solute atoms. Results show that a single mechanism, independent of the particular interaction between the dislocations and solute atoms, is responsible for solution hardening in close packed metals. Theories of solution hardening should be based on models in which the unit activation process involves the interaction between a dislocation and many solute atoms (except possibly in very dilute solutions) and predict a hardening behavior which is characterized by a single parameter of stress. (J.R.D.)

56727 INCONEL ALLOY 617: A NEW HIGH-TEMPERATURE ALLOY. Hosier, J. C.; Tillack, D. J. (International Nickel Co., Inc., Huntington, W. Va.). Metals Eng. Quart.; 12: No. 3, 51-5(Aug 1972).

The development of a W-free Ni-base alloy (Ni-base–Cr–Co–Mo–Al) designated Inconel Alloy 617 with an exceptional combination of stress-rupture strength and oxidation resistance at temperatures over 1800°F (980°C) is reported. The alloy has properties comparable to those of W-containing alloys but with lower weight, decreased cost, and greatly improved metallurgical stability. (P.C.H.)

56728 CRYSTAL STRUCTURE OF THE Ni_3Nb PHASE IN INCONEL 718 ALLOY. Choi, Hyung S.; Choi, Ju. J. Korean Inst. Metals; 10: No. 1, 8-15(1972).

The crystal structure of the Ni_3Nb phase which appears in overaged Inconel 718 was examined by selected area electron diffraction. It was confirmed that the phase has an ordered close packed layer structure with a periodic stacking modulation of the stacking order which can be specified as 2H structure. The specific stacking order of the 2H structure can be expressed as AB′AB′. The atomic arrangement of the close packed layer is identical with that of one dimensional long period superlattice of M = 1 type superstructure. (Korean Sci. Abstr.)

56729 YTTERBIUM–ALUMINUM SYSTEM. Palenzona, A. (Univ., Genoa). J. Less-Common Metals; 29: No. 3, 289-92 (Nov 1972).

The ytterbium–aluminum system has been investigated by differential thermal, microscopic and x-ray analysis. Aluminum lowers the transformation temperature of pure ytterbium from 740 to 712°C by an inverse peritectic reaction. A eutectic reaction occurs at 22.5 at. % Al and 675°C between ytterbium and the compound $YbAl_2$ which melts congruently at 1360°C. Another eutectic occurs at 96.0 at. % Al between aluminum and $YbAl_3$ which forms peritectically at 980°C. The structures and the lattice constant values of these two phases, already known, have been confirmed. No other intermetallic compound has been found in this system. (auth)

56730 NOTE ON THE STABILITY OF RARE EARTH–COBALT COMPOUNDS WITH $CaCu_5$ STRUCTURE. Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Metals; 29: No. 3, 283-8(Nov 1972).

The extension of the temperature region in which the rare earth-cobalt phases with a $CaCu_5$-type of structure are stable has been studied for all rare-earth elements except Pm and Eu. This region is limited by the melting point at high temperatures and by a eutectoid transformation at lower temperatures. It extends over about 600°C for the light rare-earth elements but decreases appreciably for the heavier rare-earth elements and vanishes altogether for the elements beyond Tm. (auth)

56731 INTERFACIAL FREE ENERGIES OF SOLID CHROMIUM, MOLYBDENUM, AND TUNGSTEN. Allen, B. C. (Battelle Columbus Lab., Ohio). J. Less-Common Metals; 29: No. 3, 263-82(Nov 1972).

The average surface free energies, γ_{SV}, of chromium, molybdenum, and tungsten have been measured at 0.6 to 0.8 of the absolute melting temperature, T_M, by multiphase equilibrations with liquid tin or silver in tantalum-gettered argon. With grain-boundary groove angles measured by interferometry and stylus profile tracing, the respective values were 1700 ± 360, 1750 ± 390, and 1810 ± 630 ergs/cm^2. Similar values for molybdenum were obtained from an analysis of the kinetics of grain-boundary grooving. Ratios involving the high-angle grain boundary, solid–liquid, and solid–foreign metal vapor interfacial free energies and γ_{SV} were consistent with theoretical considerations. The presence of surface active impurities was predicted on the basis of a positive temperature coefficient, $d\gamma_{SV}/dT$. Values of the order of +0.6 erg/cm^2/°C were calculated from the temperature dependence of grain boundary groove angles from which it was found that the relative grain boundary free energy, γ_{SS}/γ_{SV}, decreased from ~0.5 at 0.5 T_M to ~0.35 at 0.95 T_M. In the case of molybdenum, grain boundary groove angles were insensitive to environments ranging from 10^{-9} Torr residual pressure to 1.0 Torr of nitrogen. Indications of surface impurities during equilibration were given by Auger electron spectroscopy which revealed carbon and sulfur on molybdenum at 0.65 T_M under ultra-high vacuum conditions. Adjusting the surface free energy values to the melting points and dividing by the surface tension of the corresponding liquid, γ_{LV}, resulted in γ_{SV}/γ_{LV} ratios above unity, as predicted by Skapski's broken bond model. (auth)

56732 MELTING POINTS AND COMPOSITIONS OF SIGMA PHASES. Raynor, G. V. (Univ. of Birmingham, Eng.). J. Less-Common Metals; 29: No. 3, 333-6(Nov 1972).

The thermal stability of sigma phase transition alloys was studied in relation to the size factor and the difference between the group numbers of the alloy components. The size factor is the difference between the atomic diameters of the components and the group number of the components. The group number is defined as the total number of electrons outside the closed shells of the preceding inert gas elements in the Periodic Table. Both factors appeared to influence the stabilities of the sigma phases. (T.D.)

56733 ELECTROTRANSPORT OF CARBON, NITROGEN, AND OXYGEN IN GADOLINIUM. Peterson, D. T.; Schmidt, F. A. (Ames Lab., Iowa). J. Less-Common Metals; 29: No. 3, 321-7 (Nov 1972).

The electrotransport velocities of carbon, nitrogen and oxygen were measured in both the alpha and beta crystalline forms of gadolinium. Measurements were made at 1050, 1125, 1200 and 1265°C. All three solutes migrated in the same direction as the electron flow but much higher mobilities were observed in the β (b.c.c.) form. Diffusion coefficients and effective valences were calculated for these elements at the same temperatures. Electrotransport was shown to be an effective method of purifying a small amount of gadolinium as indicated by resistance ratio measurements. (auth)

Radiation Effects

Refer also to abstracts 56266 and 56598.

56734 (COO-3171-6) STUDY OF ELECTRON DAMAGE IN QUENCHED AND HELIUM PRE-INJECTED ALUMINUM. Glowinski, Lucien D. (Cornell Univ., Ithaca, N. Y. Materials Science Center). Oct 1971. 69p. Dep. NTIS.

Thesis.

Electron damage studies have been performed in pure, quenched, and helium-preinjected aluminum foils by using the 200 keV beam in a JEM 200 electron microscope. The nature of the dislocation loops produced was unambiguously determined using the diffraction contrast techniques developed first by Maher and Eyre. In pure and helium-preinjected aluminum foils the damage was found to be mainly interstitial in character. But in the quenched foils, the dislocation loops observed were about 40% of vacancy type and 60% of interstitial type. Helium preinjection can apparently enhance the damage produced in aluminum according to the results obtained in foils with and without helium preinjection. The effects of helium preinjection were observed primarily in the nucleation stage of dislocation loops but not in the growth stage as the loop density increased with helium preinjection but the average loop size remained about the same. The effects of helium were probably limited by its solubility in aluminum since it was found that a dose of 1 ppM of helium ion produced about twice more dislocation loops than a dose of 100 ppM of helium ion. In the high helium dose samples, based on Rühle's criterion on void contrast, damage in the form of cavities of sizes from 50 Å to 100Å was identified. The exact nature of such cavities has not been determined. However, based on the well-defined shape of the large cavities and the disappearance of small cavities upon electron bombardment at 100°C, it seems to be reasonable to identify the former to be gas bubbles and the latter voids. (auth)

56735 (EUR-4802) ON THE MEASUREMENT OF STORED ENERGY AND SPECIFIC HEAT OF METALS AND ALLOYS USING A DIFFERENTIAL-SCANNING-CALORIMETER. Lang, E ; Von Birgelen, G. (European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center). 1972. 78p. (In German). Dep. NTIS (U. S. Sales Only).

The characteristics of a differential scanning calorimeter and its feasibility for studies of the physical properties of metals were examined. Results indicated that this calorimeter is a very useful tool for investigations of solid state reactions in metals and alloys where the energy released, e.g., stored energy introduced by quenching, cold work or irradiation as well as energies involved in phase transformations are of the order of 0.1 cal/g and more. It is further possible to perform, by means of this apparatus, an analysis of the kinetics of such reactions. Starting from the theory of a differential heat flow-calorimeter, the methods of calibration, of determination of specific heat, the quantitative evaluation of DSC-diagrams and the determination of activation energies are discussed. Results are presented of calibration experiments, measurements of specific heat of Cu, Cu–Au, and Au–Ag alloys, as well as recovery spectra of cold-worked copper, α-brass, and Cu–25 Au alloys, investigations of phase transformations in the VO_x-system and some examples for the determination of activation energies. (auth)

56736 (EURFNR-968, pp 233-46) CREEP BEHAVIOR OF CANNING MATERIAL FOR FAST SODIUM COOLED REACTORS. Closs, K. D.

A review of stainless steel cladding material development in Germany is presented. Discussions are included on stainless steel creep behavior without irradiation, creep under steady-state conditions, creep under transient conditions, and creep under neutron irradiation. Comparisons of German and U. S. stainless steels are included. (J.R.D.)

56737 (EURFNR-968, pp 247-53) PORE FORMATION IN CANNING MATERIALS. Ehrlich, K.

The models of pore formation in canning materials previously developed are only partly usable. Qualitative arguments are therefore mainly used in setting up so-called swelling formulas. It can be shown that in case of heterogeneous nucleation, including helium, a dose dependence with an exponent $n \sim 1.5$ can be expected. The temperature dependence and influence of the cold-work are then described by adaptation to the experimental data. In this way the problem of extrapolating available results to higher neutron doses is clearly delineated as long as such formulas are employed. Nonetheless calculation treatment of the experimental values is still necessary, so that they can be successively improved. Formulas for the relative volumetric change ($\Delta V/V$) in steel are included. (auth)

56738 (EURFNR-968, pp 254-60) INFLUENCE OF HIGH TEMPERATURE EMBRITTLEMENT ON CREEP AND RUPTURE BEHAVIOR OF METALLIC MATERIALS. Wassilew, Ch.

Results of studies on high-temperature embrittlement are presented along with results of studies on effects of mechanical and thermal treatment on high-temperature embrittlement. It is noted that the present concepts concerning the mechanism of high temperature embrittlement can be used in clarifying the correlations determined experimentally. The possibilities which these ideas give of improving the irradiation behavior have been corroborated experimentally. (J.R.D.)

56739 (EURFNR-968, pp 261-8) SHORT-TIME PROPERTIES OF AUSTENITIC STEELS FOR SODIUM COOLED FAST BREEDERS. Hess, G.

The example of Sandvik steel 12R72HV is used to illustrate how radiation damage of the mechanical short-time properties after irradiation in the BR-2 at Mol can be reduced by suitable prior treatment. It is found that in particular annealing leading to a homogeneous boron distribution and to finely divided segregations in the grain and to segregations in the grain boundaries which inhibit their slip result in a marked reduction in the short-time embrittlement. The influence of mechanical and heat treatment can be seen from the results of irradiation project Mol 3C on steel 1.4988. It can be seen that after slight cold-work the ductility after irradiation is raised by post-annealing at 850°C. On the other hand, the elongation on rupture in a 50% cold-worked sample is impaired by annealing at 850°C. A direct comparison of steels 1.4988 and 1.4981 is provided by the irradiation project Mol 3C/1. Both steels were irradiated in the state 10% cold-worked plus 850°C/1 h at 650°C. Although steel 1.4988 had a higher elongation when unirradiated in this state, steel 1.4981 showed higher elongation values after irradiation. This steel was also irradiated in the project DIDO M4 after various thermal and mechanical treatments. Here also, the above-mentioned state 10% cold-worked plus 850°C/1 h yielded good results. For the sake of completeness some literature values for alloys AISI 304 and AISI 316 are also given, but direct comparison between the very different irradiation conditions is not possible. (auth)

56740 (HEDL-TME-72-108) DEFECT DEVELOPMENT IN NEUTRON-IRRADIATED TYPE 316 STAINLESS STEEL. Brager, H. R.; Straalsund, J. L. (Hanford Engineering Development Lab., Richland, Wash.). 1972. Contract AT(45-1)-2170. 34p. Dep. NTIS.

The effects of fast neutron irradiation on the defect development in unstressed, solution-treated Type 316 stainless steel were investigated by transmission electron microscopy (TEM). The irradiation conditions investigated covered the fluence range from 0.75 to 5.1×10^{22} n/cm^2 ($E > 0.1$ MeV) and temperatures from 380 to 850°C. Empirical equations were developed relating the void volume, void number density, mean void size, Frank fault loop diameter, Frank loop number density and dislocation density with the neutron fluence and irradiation temperature. Void nucleation changes from homogeneous at low irradiation temperature ($\lesssim$400°C) to heterogeneous at higher temperatures, where voids are preferentially associated with rod-shaped precipitates. The upper irradiation temperature limit for voids (about 700°C) is coincident with the upper temperature limit for the formation of rod-shaped precipitates. Void volume, or swelling, of 316 SS is about half that previously determined for Type 304 and is due primarily to a difference in number density. Swelling and void number density follow a power law that is dependent on fluence. The fluence exponent increases with increasing temperature from about 1 to 2.5 for swelling, and from about 0.2 to 1.7 for void number density over the temperature range investigated. The void number density decreases, while the void diameter increases with increasing irradiation temperature. The total loop line length per unit volume and dislocation density increases with increasing fluence and decreases with increasing irradiation temperature. The Frank loop diameter increases and number density decreases with increasing temperature. The range of irradiation temperature in which Frank faulted loop formation occurs decreases with increasing neutron fluence. These data are compared with recently reported data and with predictions of homogeneous void nucleation and growth models. (auth)

56741 (JAPFNR—38) IRRADIATION PROGRAM IN PNC. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Translation of a Japanese report. 10p. (PNC-N—141-72-1-8). Dep. NTIS (U. S. Sales Only).

A long-term irradiation program for fuels to be used in Joyo and Monju reactors is described. Programs planned for irradiation of fuels and materials in Dounreay and Rapsodie reactors are tabulated along with those for General Electric Test Reactor and Japanese Materials Test Reactor. (J.R.D.)

56742 (JUL—859-FF) RECOVERY OF ELECTRON-IRRADIATED PLATINUM. Sonnenberg, Klaus (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). May 1972. 156p. (In German and English). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Aachen, Ger.

Electric resistivity measurements were made to study the recovery in stage I of electron-irradiated Pt. The influences that exert a large variation of irradiation dose, electron energy, radiation doping, and doping with dilute concentrations of Au-atoms on the annealing structure were investigated. The recovery in substages I_A, I_B, and I_C was not influenced by irradiation dose and doping agents in agreement with the model of close Frenkel pair recombination in these stages. Substage I_E was strongly and substage I_D moderately modified by variation of radiation dose and the addition of doping agents. This and the equal values of the activation energies measured in substage I_D and I_E confirmed the model of correlated and uncorrelated recovery of free migrating interstitials in these stages. (auth)

56743 (KFK—1599) IN-PILE STRESS RUPTURE AND CREEP BEHAVIOR OF THE ALLOY INCOLOY 800. Closs, K. D.; Schaefer, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). May 1972. 18p. (In German). Dep. NTIS (U. S. Sales Only).

The in-pile stress rupture and creep behavior of two heats of Incoloy 800 were studied at 615 and 720°C. The two heats differed in C-, Al-, and Ti-content. Of the two materials investigated, the alloy that contained Ti and Al and which also had the higher C-content, showed the higher strength, the smaller rupture strains and the more pronounced reduction in time to rupture due to neutron irradiation. From rupture strain and time-to-rupture, a minimum creep rate was calculated for the unirradiated and irradiated specimens, taking into account the reduction in wall thickness and the increase in diameter during the deformation of a ductile tube under internal pressure. The minimum creep rate of the alloy without Ti and Al was not influenced by neutron irradiation, whereas the alloy with Ti and Al and the higher C-concentration showed an increase in minimum creep rate. Moreover, it was found that the stress dependence of the minimum creep rate can be described over a wide range by a hyperbolic sine law. (auth)

56744 (ORNL-TM—3732) RADIATION DAMAGE IN ANNEALED TYPE 304 STAINLESS STEEL. Bloom, E. E.; Stiegler, J. O.; McHargue, C. J. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 34p. Dep. NTIS.

The defect structures in irradiated Type 304 stainless steel were characterized by transmission electron microscopy for irradiation temperatures between 370 and 840°C and for fluences ranging from 10^{18} to 10^{23} neutrons/cm^2 (>0.1 MeV). Below about 550°C the interstitial atoms produced by the irradiation precipitate as Frank sessile loops, which decrease in concentration and increase in size with increasing irradiation temperature. Above 550°C the loops unfault and evidently glide and interact to form a loosely organized dislocation network, which becomes coarser with increasing irradiation temperature. The vacancies precipitate as voids, which also decrease in concentration and increase in size with increasing temperature. The damage appears to be first visible at a threshold fluence that increases with increasing irradiation temperature. At high fluences, void concentrations approach a saturation concentration that decreases with increasing irradiation temperature. Voids are often not homogeneously distributed but are preferentially associated with dislocations and precipitate particles. The void concentrations and size distributions are not strongly dependent on the fast neutron flux, at least over ranges encountered in fast reactors. These observations are discussed in terms of proposed mechanisms for void formation. It is concluded that most of the voids are probably nucleated on complexes of vacancies and helium atoms resulting from (n, α) transmutations. (auth)

56745 (RFP—1881) RADIATION INDUCED CORROSION OF METALS. Kazanjian, Armen R.; Horrell, David R. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 25 Aug 1972. Contract AT(29-1)-1106. 9p. Dep. NTIS.

A general survey has been made of a number of metals and organic liquids to determine their susceptibility to radioinduced corrosion. The metals were tantalum, tungsten, stainless steel 304, platinum, copper, zirconium, niobium, titanium, uranium, thorium, aluminum, silver, and molybdenum. The liquids were carbon tetrachloride, trichloroethylene, chloroform, perchloroethylene, trichlorotrifluoroethane, hexane, and Texaco Regal A oil. These metal-liquid combinations were gamma irradiated with doses on the order of 2×10^{21} eV/ml and then examined for corrosion. The metals that showed appreciable corrosion were copper, thorium, and stainless steel in most of the liquids, uranium in chloroform, and aluminum in carbon tetrachloride. The other systems were essentially unaffected by radiation. (auth)

56746 (TID—25972) RADIATION DAMAGE IN STRUCTURAL MATERIALS. Frye, John H. Jr.; McHargue, C. J. (Oak Ridge National Lab., Tenn.). 1971. 26p. (CONF-720832—1). Dep. NTIS.

From 3rd inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972).

Radiation damage in structural materials is a serious problem for reactor designers. The two most serious effects are swelling and reduction in ductility. Swelling of metals results from formation of voids, gas bubbles, and dislocation loops. Reduction in ductility is a complex phenomenon. One serious mode is the reduction of creep ductility in the temperature range where failure is due to grain-boundary cleavage. Helium, produced by transmutation of alloying elements or impurities, can collect in the grain boundaries and provide the crack nuclei. Embrittlement is also caused by point defects and clusters of defects. (auth)

56747 (TID—26147) DESIGN RAMIFICATIONS OF IRRADIATION-INDUCED SWELLING AND CREEP IN FAST REACTORS. Murray, P.; Patterson, J. F.; Pennell, W. E. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). 1971. Contract AT(30-1)-3791. 69p. Dep. NTIS.

Current estimates for irradiation-induced swelling run as high as 12 volume percent or more at fast fluence levels of 2×10^{23} n/cm^2 (E > 0.1 MeV) which is typical of current demonstration plant designs. The implications of available irradiation data are summarized and current theories of irradiation-induced swelling are discussed. Since the effects of swelling and irradiation-induced creep must be considered together in most design applications, the current position on irradiation-induced creep is also discussed. (auth)

56748 EFFECTS OF NEUTRON FLUENCE ON STEEL WELD METAL FOR REACTOR VESSELS. Grant, S. P. (Babcock and Wilcox Co., Lynchburg, Va.); Fortner, E. Metals Eng. Quart.; 12: No. 3, 17-24(Aug 1972).

A filler metal developed for medium-strength, low-alloy steels was found to be almost totally resistant to fast neutron radiation damage at 550°F up to exposures of 2.8×10^{19} n/cm^2 (>1 MeV), which is representative of current reactor vessel exposures. Freedom from damage was accomplished by restricting copper and phosphorus contents to low levels. Irradiations to very high fluences (>1×10^{20} n/cm^2 > 1 MeV) revealed that damage will occur even though copper and phosphorus are restricted to 0.03 and 0.006%, respectively. The damage, however, was not severe, and the alloy steel exhibited good Charpy V-notch ductility. Good results were obtained with a model of fast neutron embrittlement in the vicinity of 550°F. The model used residual and time-temperature parameters to plot the course of embrittlement with increasing fluence. The residual parameter consisted principally of copper and phosphorus activities, which are expressed as weight concentrations. Prior work fairly well predicted the effects of temperature, but no quantitative expression involving time is available yet. The effects of copper were attributed to the sequence of events expected in precipitation hardening. The effects of phosphorus were tied to 500°F embrittlement. Neutron radiation was essential to both embrittlement processes. The nature of these processes suggests that they may interfere with low-temperature, post-irradiation annealing treatments. (auth)

56749 APPARATUS FOR REACTOR MEASUREMENTS OF INTERNAL FRICTION AND SHEAR MODULUS OF SAMPLES. Karasev, V. S.; Grinik, E. U.; Landsman, V. S.; Efimov, A. I. At. Energ. (USSR); 33: No. 3, 777-8(Sep 1972). (In Russian).

A device is described for in-reactor measurements, consisting of an inverted torsion pendulum operating under constrained oscillation, and a remote electronic control system. The effects of neutron flux intensity on the temperature dependence of the shear modulus of nickel, and on the internal friction of iron were determined, and illustrate the capability of the device. (K.S.W.)

56750 FAST NEUTRON RADIATION SOFTENING AND RADIATION ANNEAL HARDENING IN IRON AT LOW TEMPERATURE. Vanoni, F.; Groh, P.; Moser, P. (CEN, Grenoble, France). Scr. Met.; 6: No. 9, 777-83(Sep 1972).

Three phenomena were observed in fast neutron-irradiated iron at low temperature: softening, twinning suppression, and anneal hardening. Interpretations in terms of interactions between intrinsic point defects (essentially interstitials) and edge and screw dislocations are proposed; any significant contribution from interstitial impurities can be ruled out. These interpretations must, however, be regarded as tentative; they should be confirmed by additional experiments, particularly electron microscopy observations of the dislocations. Nevertheless, it seems important to call upon the core structure of dislocations data to explore the interactions between point defects and dislocations. (auth)

56751 CRITIQUE OF L. M. BROWN'S ''A SIMPLE EXPLANATION OF VOIDS IN MATERIALS UNDER IRRADIATION''. Seidman, David N.; Balluffi, R. W. (Cornell Univ., Ithaca, N. Y.). Scr. Met.; 6: No. 9, 789-92(Sep 1972).

A refutation is presented for a conclusion by Brown [Scripta Met. 6: 387(1972)] concerning an equilibrium array of voids in materials assumed to be a general consequence of irradiation at a dose sufficiently large to produce a steady state. It is noted that the steady state is kinetically determined and not thermodynamically determined as assumed by Brown. (J.R.D.)

56752 REPLY TO THE CRITIQUE OF D. N. SEIDMAN AND R. W. BALLUFFI. I. Brown, L. M. (McMaster Univ., Hamilton, Ont.). Scr. Met.; 6: No. 9, 793-4(Sep 1972).

The reply concerns a note by the authors of a paper Scripta Met. 6: 789-792(1972). The author concludes that it is not necessary to understand the details of the nucleation of the voids to discuss a steady-state system in which nucleation is assumed to be easy. It is essential to understand the kinetics to be able to calculate the transient time or the dose required to achieve the steady state. At the moment, this seems complicated, and it may well involve dislocations. However, the concept of the ''steady state'' seems sound and worth further investigation. (J.R.D.)

56753 STUDY BY MEASUREMENT OF INTERNAL FRICTION OF RECRYSTALLIZATION OF COLD-WORKED AND γ-IRRADIATED SILVER. Isore, A.; Benoit, W. (Laboratorie de Genie Atomique, Lausanne, Switzerland). Helv. Phys. Acta; 45: 25-8 (1972). (In French)

The internal friction and the change in the elastic modulus $\Delta E/E$, was measured on 99.998%-pure silver rolled to 7% at room temperature and irradiated with γ radiation (1.33 MeV) at −70°C. The measurements were made in a bending vibration installation at 20°C after a one-hour anneal at temperatures from 50 to 350°C. The results showed that the internal friction and the elastic modulus of the samples reached their maximum values after recrystallization for anneals at the lowest temperature for the longest irradiation time. The maximum of the internal friction of the most irradiated samples was depressed toward the low anneal temperatures. The reverse is true for the maximum of the elastic modulus. The decrease of the elastic modulus between 100 and 190°C, observed on the most irradiated sample, was ascribed to the formation of 5×10^{14} defects/cm^3 on the dislocations. (J.S.R.)

Other Materials

Refer also to abstracts 55826, 56027, 56048, 56327, 56605, and 57933.

56754 (CEA-CONF–1891) MECHANICAL STRENGTH OF GRAPHITE SUBMITTED TO NEUTRON INDUCED CORROSION. Schill, R.; Jouquet, G.; Yvars, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1971. 3p. (In French). (CONF-720609–7). Dep. NTIS (U. S. Sales Only).

From International carbon conference; Baden-Baden, Germany (26 Jun 1972).

Under pressure of carbon dioxide, workpieces of nuclear graphite were subjected to neutron irradiation at 400°C. Variations of tensile stress were observed. These variations were due to two combined phenomena. Irradiation leads to an increase of mechanical strength but radiolytic corrosion to its decrease. An analytical relation was developed, making allowance for these mechanisms which seems to be in good agreement with experimental results. (auth)

56755 (CEA-CONF–1892) GRAFT-POLYMER ON CARBON FIBRES. Riess, G. (Ecole Superieure de Chimie, Mulhouse (France); Brie, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1971]. 2p. (In French). (CONF-720609–6). Dep. NTIS (U. S. Sales Only).

From International carbon conference; Baden-Baden, Germany (26 Jun 1972).

In order to increase the mechanical properties of carbon fiber-reinforced resins, a copolymer, compatible with the resin, was grafted onto the latter. The shearing tensile strength of this composite increased from 5.6 kg/mm^2 ± 0.3 to a value between 8 to 9 kg/mm^2. When using a block copolymer A–B (A = elastomer sequence, B = sequence compatible with resin), increases were found on the shearing strength (8.1 kg/mm^2 ± 0.3) and also impact resistance (0.63 daJ/cm^2 instead of 0.40 daJ/cm^2). (auth)

56756 (CEA-CONF–1893) GRAPHITE MADE OF GILSONITE COKE. ''ITS IRRADIATION BEHAVIOUR''. Micaud, G.; Rappeneau, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires); Lore, J.; Cornuault, P. (Compagnie Pechiney, Paris (France)). 1972. 3p. (In French). (CONF-720609–5). Dep. NTIS (U. S. Sales Only).

From International carbon conference; Baden-Baden, Germany (26 Jun 1972).

The behavior of a graphite made of Gilsonite coke under neutron irradiation was investigated. Samples of this graphite were irradiated in different reactors (D.F.R., OSIRIS) at 270 to 700°C and a maximal irradiation dose of 1.3×10^{22} n/cm^2 E.D.N. The dimensional changes, as well as the coefficients of expansion and thermal conductivity versus irradiation dose, have been investigated. Under the irradiation conditions, the investigated graphite shows a contraction in two preferential directions in every case. (auth)

56757 (DP-MS–72-15) EFFECTS OF RADIATION ON REACTOR CONFINEMENT SYSTEM MATERIALS. Jones, L. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. Contract AT(07-2)-1. 22p. (CONF-720823–4). Dep. NTIS.

From twelfth air cleaning conference; Oak Ridge, TN. (28 Aug 1972).

Materials for airborne-activity confinement systems are being irradiated by a ^{60}Co source at a rate of ~4×10^7 rads/hr to simulate the performance characteristics of the materials following a reactor accident. In a reactor accident, radioiodine and radioactive particulates would accumulate in the confinement system and would produce an intense radiation field. The materials are being irradiated in a miniature confinement system containing a moisture separator, a HEPA filter, and a carbon bed in series. Single materials are also being irradiated. Test facilities and qualitative measurements of changes in pertinent material properties during irradiation are described. On November 9, 1970, about 160,000 curies of particulate activity was released into the K reactor room from an irradiated antimony-beryllium source rod that melted while suspended in air. Approximately 6247 curies reached the confinement filters; only 3 millicuries escaped to the environs. Inspection of contaminated filter components for radiation damage is described. (auth)

56758 (SGAE–2028) CHANGES OF PROPERTIES OF PYROGRAPHITE LAYERS ON FUEL PARTICLES UNDER REACTOR IRRADIATION. Koss, P.; Wallisch, K. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Metallurgie). Jul 1972. 9p. (In German). Dep. NTIS (U. S. Sales Only).

The structure and anisotropy of pyrocarbon coatings on fuel particles change during service in the reactor. This limits the maximum burnup of the fuel in high temperature reactors. A systematic survey of the dependence of anisotropy changes on burnup, fast neutron dose, and temperature was performed. It was shown that the fast neutron dose and the fission gas pressure in the particle caused by the burnup are the major parameters. The results are interpreted using a simple model. (auth)

56759 UV INDUCED THERMOLUMINESCENCE ON NATURAL CALCIUM FLUORIDE. Okuno, E. (Sao Paulo Univ., Brazil); Watanabe, S. Health Phys.; 23: No. 3, 377-82(Sep 1972).

Samples of a green variety of fluorite found at Criciuma, Brazil, annealed at 580°C for 10 min and then at 400°C for 2 hr were exposed to 365 nm uv light. The transferred TL from deep trap to lower temperature trap gives rise to a flow curve containing peaks I, II, III′, III and IV in a readout up to 400°C. This TL response was measured as a function of uv exposure time t and the result is not a saturation curve, but TL tends to zero for large t indicating a simultaneous bleaching effect. The curve of TL vs number n of cycles in an exposure-readout cycle was obtained for different durations of exposure in each cycle. For large n the rate of decrease of log (TL) is independent of the time interval of exposure to uv light in each cycle. The effect of duration and temperature of pre-annealing on TL transfer under uv exposure as well as the dependence of transferred TL on previous gamma radiation were investigated. A mathematical model is proposed. (auth)

56760 HYDROGEN EVOLUTION ON PYROLYTIC GRAPHITE. Despic, A. R.; Drazic, D. M.; Savic-Maglic, G. A.; Atanasoski, R. T. (Univ., Belgrade. Inst. of Chemistry, Tech., and Metallurgy, Belgrade). Croat. Chem. Acta; 44: No. 1, 79-87(1972).

The hydrogen evolution reaction from acid solutions was studied on highly oriented pyrolytic graphite at different surfaces obtained by cutting graphite under the various angles in respect to the basal plane. The experiments were done galvanostatically on the polished samples of desired orientation, in a cell which enabled the pretreatment of graphite at 1000°C in argon and use of prepurified Na_2SO_4 + H_2SO_4 solutions. Tafel lines with 2 RT/F slopes were obtained in all the experiments with i_0 varying from ca ≈ 10^{-9} A/cm^2 for cleavage plane to ca = 10^{-8} A/cm^2 for edge plane. The transients show the considerable pseudo-capacitances of 250 to 500 μF/cm^2 being larger at more negative potentials and edge surfaces. The experimental data are consistent with the slow discharge—electrochemical desorption mechanism with the limited number of sites of H adsorption but also with the coupled discharge—recombination reaction for hydrogen evolution. (auth)

56761 CRYSTAL STRUCTURE OF α $SrUO_{4.000}$. Sawyer, J. O. (Western Australia Univ., Nedlands). J. Inorg. Nucl. Chem.; 34: No. 10, 3268-71(Oct 1972).

During a study of the phase systems $MO-UO_2-O_2$ (M = Ba, Sr, Ca,and Cd), a monophasic sample of α $SrUO_{4.000}$ was prepared and characterized by x-ray and chemical analyses. The sample, yellow in color, had a mole composition of $SrO/UO_{3.00\pm0.002}$ = 0.998. The Hagg–Guinier x-ray pattern of α $SrUO_{4.000}$ may be indexed in terms of an orthorhombic unit cell by analogy with the unit cell reported for $BaUO_4$, the crystal structure of which was determined using single crystal methods (Samson and Sillen, 1947). To confirm the isostructural relationship between $BaUO_4$ and α $SrUO_{4.000}$ a diffractometer pattern of α $SrUO_{4.000}$ was recorded on a Phillips x-ray diffractometer using CuK_α radiation. Calculated intensities were prepared using the atomic co-ordinates of $BaUO_4$. The structure of α $SrUO_{4.000}$ differs only slightly in the oxygen atom co-ordinates from that of $BaUO_4$. Within the accuracy of the structure determination the structure is adequately described by space group D_{2h}^{11}–Pbcm. (UK)

56762 IMPROVEMENTS TO TECHNIQUES OF HARDENING PAINTS AND VARNISHES BY IRRADIATION. Meunier, Jean-Paul (to Conservatome). French Patent 2,095,171. 11 Feb 1972. Filed 4 Jun 1970. (In French).

A process for hardening paints and varnishes covering a substrate is described. The process consists of coating the substrate with a layer of varnish or paint, solidifying this coating with a preliminary dose of irradiation, and then depositing a layer of inert protecting liquid on the first layer. This second layer is hardened by irradiating it with a second dose of irradiation; the protecting liquid is then eliminated. The varnish or paint may be solidified by other means, e.g., drying. The protecting liquid is then eliminated after the hardening of the varnish or paint, a second dose of irradiation being used. (France)

56763 PLUTONIUM HEXAFLUORIDE REDUCTION. Heady, Orville E.; Towell, John F.; Standifer, Richard L. (to United States Atomic Energy Commission). U. S. Patent 3,671,199. 20 Jun 1972. Filed 4 Mar 1969.

A description is given of an apparatus and method for reducing plutonium hexafluoride to plutonium tetrafluoride by heating the plutonium hexafluoride in a first zone, then mixing the heated plutonium hexafluoride with hydrogen in a second zone and collecting solid plutonium tetrafluoride in a third zone, while removing gas and gaseous products from the second zone. (Official Gazette)

56764 ELECTROCOATING APPARATUS WITH IONIZING RADIATION MEANS. Smith, Arthur G.; Turner, Allen H. (to Ford Motor Co.). U. S. Patent 3,679,572. 25 Jul 1972. Filed 1 Dec 1969.

A coating bath comprising paint binder resin is dispersed as anionic electrolyte in aqueous medium and characterized by being anodically depositable therefrom as a paint film that is crosslinkable by ionizing radiation having average energy in the range of 100,000 to 450,000 electron volts. In one embodiment, the major fraction of the paint binder resin is a homopolymerizable, alpha-beta olefinically unsaturated resin having per molecule at least one carboxyl group ionizable in the aqueous medium of the bath. In another embodiment, the major fraction of the paint binder is an alpha-beta olefinically unsaturated resin having per molecule at least one carboxyl group ionizable in the aqueous medium of the bath and a cross-linkable amount of vinyl monomers. Apparatus for use in electrodepositing and curing this coating material is also disclosed. (Official Gazette)

56765 THERMAL EXPANSION AT ELEVATED TEMPERATURES. III. A HEMISPHERICAL LAMINAR COMPOSITE OF PYROLYTIC GRAPHITE, SILICON CARBIDE AND ITS CONSTITUENTS BETWEEN 300 AND 800 K. Pojur, A. F.; Yates, B.; Kelly, B. T. (Univ. of Salford, Eng.). J. Phys., D (London); 5: No. 7, 1321-9(Jul 1972).

Attention is drawn to attempts which have been made to calculate thermal and elastic properties of particle-, fiber- and laminar-reinforced composite materials from corresponding properties of their constituents. Results of measurements of the linear coefficients of thermal expansion of small (~0.5 mm) hollow hemispherical specimens of pyrolytic graphite, silicon carbide, and triplet hemispherical composite specimens of these components over the approximate temperature range 300 to 800°K are reported. It is shown how dilation in such composite structures is amenable to the application of classical elasticity theory, and how agreement between the results of such calculations and observation provides evidence for the absence of layer separation resulting from constrained expansion. (auth)

56766 USE OF ELASTOMERS IN NUCLEAR REACTORS. Eude, J. C. (CEN de Saclay, Gif-sur-Yvette, France). Rev. Gen. Caout. Plast.; 49: No. 5, 395-7(May 1972). (In French).

The principal applications of elastomers in the nuclear reactor domain are: sealing joints, valve flaps, points and coatings, and thermal and electrical insulators. Elastomers having special properties are required for certain applications: applications in the presence of radiations; use in contact with special fluids, e.g., CO_2(EL-4), liquefied Na of Phenix, or demineralized water. Some examples of problems encountered by the CEA are cited: joints of the Phenix plug and the EL-4 plug and incidents that have occurred with the valve flaps in EL-4. (France)

56767 EFFECT OF IONIZING RADIATION ON THE MECHANICAL PROPERTIES OF FILAMENTS OF CELLULOSE AND ITS ESTERS. Panchenkov, G. M.; Kaushanskii, D. A.; Gel'tser, G. A.; (and others) (Inst. of Petrochemical and Gas Industry, Minsk). Dokl. Akad. Nauk BSSR; 16: No. 1, 42-4 (Jan 1972). (In Russian).

The effect of ^{60}Co γ radiation in the amount of 5 to 100 MR on the mechanical properties (breaking strength, elongation at rupture) of viscose and cellulose acetate fibers was studied. Irradiation was conducted both in a vacuum and in air; dose levels were established at which breaking strength and elongation at rupture were reduced to 50%, and complete disintegration of the fibers resulted. Cellulose and cellulose acetates were found to decompose rather readily by 50 to 80 MR of gamma radiation either in vacuum or in the air. (tr-auth)

56768 CLASSICAL AND MODERN TECHNIQUES USED IN THE DRYING OF PAINTS. Grandou, P. Peintures, Pigments, Vernis; 48: No. 6, 371-81(Jun 1972). (In French).

The drying of paints by radioinduced polymerization is discussed. Gamma radiation is not very useful for this purpose. The process is carried out, normally, using β radiation; the depth of penetration of these particles can be controlled. Applications of UV, IR, and microwave radiations are also studied. (France)

56769 DESORPTION OF WATER VAPOUR BY GAMMA IRRADIATION. Galron, H. (Israel Atomic Energy Commission, Yavne). Vacuum; 22: No. 6, 229-31(Jun 1972).

The desorption of water vapour from an unbaked 304 stainless steel vacuum vessel, wall thickness 0.5 mm, by means of gamma irradiation was measured. Small ^{60}Co sources (gamma energy 1.3328 MeV, 1.1733 MeV) were attached to the outer side of the vessel and the desorption of water determined with a magnetic gas analyzer. The outgassing effect was of the order of 10^{-13} torr 1/cm^2 sec, per μCi of ^{60}Co. (auth)

56770 RADIATION EFFECTS ON THE WELDABILITY AND ADHESIVENESS OF POLYETHYLENE. Kimura, Hiroshi; Yamaguchi Takuji; Imachi, Masaki; Uematsu, Masakazu (Fukui Univ., Japan). Fukui Daigaku Kogakubu Kenkyu Hokoku; 19: No. 1, 35-43(Mar 1971). (In Japanese).

Studies were made on the effects of irradiation by ^{60}Co on the fundamental characteristics, weldability, and adhesiveness of polyethylene. High pressure polyethylene films, 0.07 mm in thickness, were exposed to various irradiation doses up to

5×10^7 R under various surrounding conditions. Measurements of degree of crystallization, resolution rate in xylene, wettability, and others were made. The materials were welded with a heated tool or bonded by various adhesives and then experiments on bonding strength were performed. The results showed that crystal decay and change of degree of crystallization in the irradiated polyethylene were not recognized. It was concluded that the increase of cross linking due to irradiation decreased weldability, and carbonyl groups, whose existence was revealed by infrared spectra analysis, improved adhesiveness. (Japan)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 55749 and 56072.

56771 (BNL-50351) PASSIVE GAMMA-RAY SCANNING OF PLUTONIUM RECYCLE FUEL RODS. Higinbotham, William A. (Brookhaven National Lab., Upton, N. Y.). 27 Jun 1972. 30p. Dep. NTIS.

In 1971, the USAEC and several commercial nuclear companies conducted a joint plant instrumentation program to evaluate several non-destructive safeguards measurement techniques. Results of passive gamma-ray fuel rod scanning at a General Electric and a Westinghouse fuel fabrication facility are presented. The rods contained mixed PuO_2-UO_2 pellets, typical of plutonium recycle fuel for light water reactors. Counting rates for gamma rays of the fissile isotopes of plutonium were high enough to detect non-specification pellets and to measure rod content of plutonium to one percent in a few minutes. ^{238}U was measured less precisely. Typical counting rates are given for gamma-rays of different energies and from different isotopes. (auth)

56772 (CONF-720627-, pp 11.1-21) CONSTITUTIONAL AND ASSOCIATED ISSUES. Richardson, J. E. (Australian National Univ., Canberra).

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

A study was made on the constitutional power of the Commonwealth of Australia and its states to promote and regulate the search for and production of nuclear raw materials and the use of nuclear energy for various purposes in Australia. The extent to which the division of legislative powers between the Commonwealth and the states affects the development of a national integrated policy was considered. (Australia)

56773 (KFK-1103) SAFEGUARDS STATEMENTS BASED ON RELEVANT COMPONENTS OF MATERIAL UNACCOUNTED FOR (MUF). Avenhaus, R.; Gupta, D.; Singh, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Apr 1972. 30p. (CONF-711037-4). Dep. NTIS (U. S. Sales Only).

From Panel on quantitative data and results of systems analysis and integral tests; Vienna, Austria (4 Oct 1971).

It is generally accepted that material accountability is one of the most important safeguards measures. The result of the material accountability during one inventory period is a statement at the end of the inventory period whether or not the difference between the book inventory and the physical inventory (Material Unaccounted For, MUF) is significant. Therefore, the analysis of MUF is of central importance. A two-part discussion of MUF is presented. In the first part the possible components of MUF (random and systematic errors, process losses etc.) are collected. With the help of historical data statements are made on the relative orders of magnitude of these components. In the second part the possible statements on MUF of the safeguards authority are analyzed, in the case of one inventory period as well as in the case of a sequence of inventory periods. In the latter case special attention is given to the problem of propagation of errors of the first kind. The relations between the relevant parameters error first and second kind, critical mass, number of inventory periods and variance of MUF are illustrated with the help of nomographs. (auth)

Disposal and Storage

Refer also to abstracts 56074, 56078, and 56277.

56774 (ARH-374) 244-AR VAULT INFORMATION MANUAL. Francis, C. J. (comp.) (Atlantic Richfield Hanford Co., Richland, Wash.). 15 Apr 1968. 127p. Dep. NTIS.

The Waste Management Program provides for the removal and separation of the long-lived Cs and Sr from current and stored Purex high-level wastes. Descriptions are given of the 244-Ar Vault facilities, which were designed to provide the capability of removing, treating, and transferring Purex tank farm sludges to 221-B Plant for fission product removal, to provide interim storage for Purex Acid Waste (PAW) feed to 221-B Plant, and to receive and distribute the neutralized high-level 221-B Plant waste. A general process description of the streams processed through the 244-Ar Vault facilities is also given. (P.C.H.)

56775 (BNWL-tr-76) QUESTION OF ENERGY STORAGE IN SOLIDS BY NUCLEAR IRRADIATION IN THE CASE OF HIGHLY RADIOACTIVE WASTE STORAGE. Laser, M.; Merz, E. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Chemische Technologie). Translated for Battelle Pacific Northwest Labs., Richland, Wash., from report JUL-766-CT. 26p. Dep. NTIS.

The hazards of a sudden energy release from solidified radioactive wastes as well as from salt in which the material is stored are analyzed. The discussion includes energy storage in solids, interaction between nuclear radiation and solid material, and defect formation in solids. Subsequently, energy storage in salt and glasses used for final disposition of highly radioactive waste is assessed. Glasses are treated with respect to absorption, release, and longtime storage of energy. Salt is considered as a vehicle for energy storage. (H.B.G.)

56776 (CONF-720627-, pp 9.1-19) MANAGEMENT OF WASTES FROM IRRADIATED NUCLEAR FUELS. Hespe, E. D.; Hardy, C. J. (Australian Atomic Energy Commission, Sydney). (AAEC/TM-628).

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

The fuel of present and future proposed power reactors has to be withdrawn from the reactor before all the fissile material is used, and it is economically desirable to recover this material. About 99.9% of the fission products present in the irradiated fuel are usually isolated in an aqueous nitrate solution in the reprocessing plant which recovers the unused uranium and the newly-created plutonium. It is this waste which, without proper management, could present a significant radiological hazard to this and future generations. Because of their abundance and relatively long half-lives, the fission product isotopes of most concern are cesium-137 and strontium-90. Small amounts of transuranic elements are also of concern because they have very long half-lives and high radiotoxicity. The amount of waste produced is proportional to the total nuclear power production, and it will require surveillance for thousands of years. The wastes release up to 20 kilowatts of energy per ton of fuel reprocessed and hence may require cooling in the early years of storage. The main concern in waste management is the possibility that the wastes may become dispersed in the environment, be ingested by man, and thus expose him to internal radiation injury. All the major producers of these wastes use some form of storage in tanks as an interim measure. All have worked, or are working, on the development of processes to convert the wastes to insoluble high melting point solids for final storage. The methods of ultimate disposal of the solids that have been developed so far, or have been proposed, are reviewed. Significant amounts of irradiated fuel are unlikely to arise from an Australian nuclear power program before the 1980's and the various factors which will have to be considered before a decision is taken to build a reprocessing plant are listed. An important question is where the long-term responsibility for waste management should lie, and this is discussed briefly. Responsible people in Western Europe have recently expressed confidence that the use of nuclear power need not be limited by waste management problems. Australia is fortunate in being able to observe and profit from the experiences of other countries, and it is concluded that the role of nuclear energy in Australia's development will not be limited by these problems. (Australia)

56777 (NP-19420) SAFETY AND ENVIRONMENTAL ASPECTS OF NUCLEAR POWER. Crancher, D. W. (Australian Atomic Energy Commission). Jun 1972. 32p. Dep. NTIS (U. S. Sales Only).

The nuclear industry has been carefully regulated to comply with strict health standards. All radioactive wastes are carefully controlled and audited and their discharges into the environment are permitted at levels which comply with national and international health standards. These are considered with respect to radioactivity and health, permissible levels of exposure, sources and control of radioactive waste, measures taken to protect against accidents, environmental aspects of discharge, and air pollution from alternative energy sources. (Australia)

56778 (ORNL-4789) THERMAL ANALYSIS OF THE NATIONAL RADIOACTIVE WASTE REPOSITORY: PROGRESS THROUGH MARCH 1972. Cheverton, R. D.; Turner, W. D. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 84p. Dep. NTIS.

Thermal studies are continuing in connection with the burial of radioactive wastes in a salt formation similar to that at Lyons, Kansas. Parametric studies pertaining to high-level waste were recently conducted in which room size, waste package array and spacing, waste age, and power per package were variables. The objective of the studies was to aid in determining optimum burial conditions. Room widths of 15, 30, and 50 ft and waste ages of 1 to 100 years at the time of burial were considered. The previously used three-dimensional heat conduction code was revised to include the temperature dependence of the thermal conductivity, and criteria associated with limiting temperatures were modified to achieve a greater degree of consistency for the different room sizes and package arrays. Results from the analysis show that, independent of waste age, there is an advantage in using the 15-ft room, based on repository mining costs and gross space requirements. In connection with the latter requirements the preference for the smaller room size is restricted to the maximum permissible loading condition. Delaying burial of the waste until about 10 years after the parent fuel is discharged from the reactor also appears to be beneficial. The calculated maximum permissible loading per gross acre for 10-year-old waste is 6 metric tons of waste nuclides, which corresponds to 158 kW/acre at the time of burial. Considering the lowest expected thermal conductivity and permissible temperature for any of the presently anticipated wastes, and assuming a container diameter of 12 in., the maximum permissible initial (time of burial) power per waste package is 5 kW (independent of waste age). The limiting power for a 6-in.-dia container is about 3 kW. A limitation on power per package is also imposed by various waste package handling operations within the repository. Thermal considerations limit the power for a 6-in.-dia container to 5 kW, independent of waste age, while transporter shielding limits the power to 3.3 kW for 1-year-old waste; however, the permissible level is greater than 5 kW for wastes older than about 3.2 years. A few calculations were made to determine the effect of varying the waste package arrays within a room. Indications thus far are that there is little difference in permissible loading surface density for one, two, and three rows in a 15-ft room and for two and three rows in a 30-ft room. It is tentatively concluded that the addition of more rows will not introduce significant changes. Thus the parametric analysis applies to very low power levels per package, accommodated by numerous rows, as well as to the higher power levels for which the calculations were made. Calculations have also been made with regard to temperatures in the high-level repository fringe areas (adjacent rooms, corridors, shafts, etc.), and in connection with the burial of cladding hulls and alpha wastes. Neither of these cases appears to pose particularly difficult thermal problems. (auth)

56779 PROBLEM OF RADIOACTIVE WASTE DISPOSAL. Kolychev, B. S.; Kulichenko, V. V.; Rauzen, F. V. At. Energ. (USSR); 33: No. 3, 723-7(Sep 1972). (In Russian).

A review of papers of Fourth International Conference on Peaceful Uses of Atomic Energy is presented. The status of investigations in the field of decontamination of liquid and gaseous radioactive waste, and progress in waste solidification and burial, is elucidated. (auth)

56780 FUTURE MANAGEMENT OF RADIOACTIVE WASTES IN AUSTRIA. Com. Naz. Energ. Nucl., Notiz.; 18: No. 7, 50-3 (Jul 1972). (In Italian).

The possibilities for disposing of high-level radioactive wastes from nuclear power plants in Austria are discussed. (auth)

Handling Equipment and Procedures

Refer also to abstracts 56057, 58305, and 58306.

56781 (AECL-4256) UNIVERSAL CELLS AT THE CHALK RIVER NUCLEAR LABORATORIES. Manson, R. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Sep 1972. 44p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

A general description of the Universal Cells at the Chalk River Nuclear Laboratories was written as part of a submission to the Nuclear Safety Advisory Committee. (auth) (Canada)

56782 (ARH-SA-118) FIRE PROTECTION IN CAVES, CANYONS, AND HOT CELLS. Lee, H. A. (Atlantic Richfield Hanford Co., Richland, Wash.). Aug 1972. Contract AT(45-1)-2130. 32p. (CONF-720823-5). Dep. NTIS.

From twelfth air cleaning conference; Oak Ridge, TN. (28 Aug 1972).

Results of a study on fire characteristics in caves, canyons, and hot cells are presented. Methods of detecting and extinguishing fires are outlined. Tests have been made of various methods for detecting and extinguishing fires in a full-size simulated process cell. Information is presented on fire development, detection and extinguishing times for fires in typical hot cells. Data are presented on smoke density and particulate size from fires of typical hot cell combustibles. Attempts were made to cool and remove the particulate matter from the gaseous effluents from these fires. Data were taken on temperature patterns and their effect on the optimum location of fire detectors. Results are presented on the effect of a fire on the ventilation system, such as turbulence within the hot cells, pressure, gas volumes, and mixing of the hot gaseous effluents with effluents from adjacent hot cells. Future efforts will be directed toward studying problems of detecting and extinguishing fires in heavily shielded cells using a wider variety of combustibles, as well as studying the role radioactivity plays in hot cell fires. (auth)

56783 (JAPFNR-39) POST IRRADIATION FACILITIES OF PNC. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Translation of a Japanese report. 13p. (PNC-N-141-72-1-9). Dep. NTIS (U. S. Sales Only).

Irradiation facilities associated with the Joyo fast experimental reactor are described. Descriptions are included of an alpha-gamma facility, a materials monitoring facility, and a fuel monitoring facility. (J.R.D.)

56784 (NIRS-Pu-7, pp 10-11) STUDY ON SAFETY PROBLEMS OF Pu AEROSOL INHALATION APPARATUS BY THE APPLICATION OF ACTIVABLE TRACER (Eu) AEROSOLS. Watanabe, Seiki; Ohno, Shigeru; Hongo, Shozo; Suzuki, Masashi (National Inst. of Radiological Sciences, Chiba (Japan)). (In Japanese).

Based on experiences with glove boxes for Pu, it is reported that $^3/_4$ of the incidents with glove boxes were due to failures of the gloves, ranging from small pinholes to large cracks. Therefore, a study on the safety testing of the Pu aerosol inhalation apparatus (glove box-type) that was designed and constructed by the authors was carried out by using submicron aerosols of Eu as an activable tracer for the safety of experimenters. In the study, several possible incidents were designed and the determination of the leak rate of Eu submicron aerosols from inside the glove box to the laboratory working environment under normal operation conditions was attempted for each incident. Three types of aerosol monitors (personal air sampler, portable air sampler, and fixed air sampler) were used for the evaluation of air contamination of the working area in the incidents. The leak rate rarely surpassed 0.01%, but failure of the gloves with immediate glove operation could cause slight air contamination in the operators' position, particularly in the case of large leaks as in a cut of the finger parts. It is considered that the rupture of a glove during the operation would cause considerable hazard to the operator. It should be pointed out that the fixed air sampler on the wall could very poorly indicate accidental air contamination at the working position compared with the personal and portable air samplers. Europium aerosols collected on the millipore filter of each sampler were quantitatively analyzed by neutron activation analysis with a neutron flux of 10^{12} n/cm^2/sec, with a detectable limit of 1 to 0.1 mg. (10^{-9} to 10^{-10} g). The protection factor of glove box operation in various incidents could be determined quantitatively by the method without danger to the operators. (auth)

56785 METHOD OF FILLING FUEL CANS. Menissier, Pierre; Pajot, Jacques (to Commissariat a l'Energie Atomique). French Patent 2,092,779. 28 Jan 1972. Filed 18 Jun 1970. (In French).

This equipment for filling a fuel can with a stack of pellets (weighing between p and p + dp) consists of an automatic introduction assembly, a tube device containing n pellets, a means of automatically transferring the tube device to a balance associated with a discriminator system which rejects the stack when its weight exceeds p + pd, a mechanism for inserting 1 to m supplementary pellets in the tube device, a rejection device acting when the weight of the stack is less than p, the difference between p and the weight of the stack being equal to the mean weight of the m pellets. The equipment also possesses an automatic assembly for measuring the length of the stack and the reject when it exceeds a given interval. The assembly for measuring the length controls a system which adds spacers until this length reaches a second determined interval. (France)

56786 DEVICE FOR CONTROLLING THE AXIAL DISPLACEMENT OF A RECTILINEAR PART. Recroix, Herve (to Commissariat a l'Energie Atomique). French Patent 2,087,100. 31 Dec 1971. Filed 5 May 1970.

A guiding device for controlling the coaxial movement of a part (possibly possessing helicoidal finning, e.g., nuclear fuel pins is presented. The device possesses two ball races coaxial to the axis along which the movement takes place, and symmetrically arranged with respect to the plane normal to the displacement. The races are maintained in contact with the axis by springs. The device also possesses two tubular guides, provided with longitudinal slits. One of these guides is fixed; the other guide moves in relation to the pitch of the finning. This device, can be used for the positioning of a fuel pin for γ spectrometry control. (France)

56787 EQUILIBRIZED SYSTEM. Guilbaud, Jean Pierre; Vertut, Jean (to Commissariat a l'Energie Atomique). French

Patent 2,086,976. 31 Dec 1971. Filed 15 Apr 1970. (In French).

An equilibrized system for a moving level pivoting about a point (e.g., telemanipulator arm), is presented. The system functions for any position assumed by the element to be equilibrized, and readily enables all the necessary adjustments to be made during operation. It possesses at least one spring joined to the movable lever at one of its ends, and to a fixed point at the other end. Both joining points are situated in a vertical plane, which passes through the pivoting point and contains the center of gravity of the lever. The resultant weight of the assembly (lever and spring) applied to the joining point of the movable lever is equal to the product of the distance of the fixed joining point from the pivoting point and the elastic constant of the spring. (France)

56788 SYSTEM FOR TRANSFERRING FISSILE MATERIAL. Druais, Roland; Falchetti, Albert; Maigret, Claude; Pajot, Jacques (to Commissariat a l'Energie Atomique). French Patent 2,092,674. 28 Jan 1972. Filed 5 Jun 1970. (In French).

A system for transferring fissile material between several glove boxes, in which machining operations or treatments are carried out, is presented. A continuous transfer system is positioned horizontally above (and in line with) the glove boxes. A horizontal sealed casing encloses this system, an appropriate drive system, being provided. Sealed joints are formed between vertical casings connecting the glove boxes to this transfer system. A sliding carriage housed in this transfer system is provided with a winch device, the fissile material being attached to cables connected to this winch device. (France)

56789 IMPROVEMENTS TO GLOVE BOXES. (to Piercan, le Latex de France). French Patent 2,092,634. 28 Jan 1972. Filed 3 Jun 1970. (In French).

A plastic sleeve provided with very large fingers in the form of a glove or a mitten is presented. This sleeve is fitted to a glove box and used for the transfer or transport of contaminated or sterile objects in a noncontaminated atmosphere. After transfer of the contaminated or sterile object to the lower part of this sleeve, the sleeve is sealed in such a way as to separate the object from the upper part of the sleeve. This closed part of the sleeve is cut away from the rest, the object thus being contained in a closed sealed envelope. (France)

56790 GAMMA-RAY SOURCE CONTAINERS. West, A. (Langley Alloys Ltd., Slough, Eng.). Brit. J. Non-Destruct. Test.; 14: No. 5, 149-50(Sep 1972).

Suggestions are made of the information which purchasers of γ-ray source containers would like to receive with the equipment. Ideas concerning modification of the locking device of the container, supply of a remote-operation winding gear to open the lid or deliver the source along a delivery tube, inclusion of a method of locating stuck sources, modification of tyres and provision of beam alignment devices for narrow beam collimators are given. (UK)

56791 EXPERIMENTAL LABORATORY OF SCALBATRAIO. Guerrini, B.; Lanza S.; Mazzini, M.; Mirandola, R. (Univ., Pisa, Italy). Com. Naz. Energ. Nucl., Notiz.; 18: No. 7, 29-41(Jul 1972). (In Italian).

Safety aspects of the routine operation of the Experimental Laboratory of Scalbatraio (near Pisa) are considered including: containment systems, programs for action in case of a nuclear incident, and transport of radioactive materials. Diagrams showing room arrangement and laboratory testing facilities are depicted. Equipment for air filtration through activated carbon is discussed. (K.S.W.)

Transportation

Refer also to abstracts 58305 and 58306.

56792 (NEDO-10093) CALCULATED FUEL ROD PERFORATION TEMPERATURES: COMMERCIAL POWER REACTOR FUELS. Smith, C. W. (General Electric Co., San Jose, Calif. Reactor Fuels and Reprocessing Dept.). Sep 1969. 16p. (69-NED-20).

In the shipment of irradiated fuels from commercial power reactors, one item of primary interest required for licensing of the shipping cask is the release of fission gases from the fuel under severe hypothetical accident conditions. The principal efforts reported here are directed toward determining the temperatures at which the fuel rods will perforate and the quantities of radioactive fission gases available for release following perforation. It is recommended that in the case of irradiated fuel shipments, the current limitations on noble gas release should be raised by at least a factor of 10 for ^{85}Kr to account for the differences in dose per curie released relationship between ^{85}Kr and most of the other noble gas isotopes. (auth)

56793 CASK FOR SPENT NUCLEAR FUELS. Schabert, H.-P. (to Siemens AG). German Patent 1,514,389. 17 Jul 1969. Filed 27 Jan 1965. (In German).

The transport cask for spent fuel elements is characterized by the fact that it contains a lining for protection against radiation, the exterior steel wall of the container is fitted with a supporting pivot surrounded by a thermal insulating layer that is adjustable, and it also has a protective cover that is connected in the center by metallic crossbars of known thermal conductivity to the same steel wall. (P.C.H.)

PARTICLE ACCELERATORS

Design, Development, and Operation

56794 (AD–736272) LOW-IMPEDANCE SIMULATOR STUDIES. Final Report, March 15, 1969–March 30, 1970. Bell, William R.; Cheever, Richard N.; Cooperstein, Gerald; Crocker, Richard; Harris, Neville W. (Ion Physics Corp., Burlington, Mass.). 30 Apr 1970. Contract DASA09-69-C-0091. 316p. (DNA–2782-F). NTIS.

Work done in support of the low impedance pulsed electron beam generator development goals of the Defense Atomic Support Agency is reported. The purpose of the work was the development of new technology upon which the design of future low impedance simulators can be based. Of particular interest are the results obtained using gas trigatron switches with a coaxial water-insulated PFN to drive an electron beam diode. The low prepulse and repeatable switch characteristics resulted in very reproducible and predictable electron beams. The beam diode and the transition connecting it to the PFN were studied experimentally and analytically in an attempt to obtain improved energy flow. Computer modelling work is described and laboratory measurements on scale models are reported. (auth) (GRA)

56795 (CONF-720717–7) ALTERNATES TO THE CYCLOTRON FOR HEAVY-ION ACCELERATION. Martin, J. A. (Oak Ridge National Lab., Tenn.). [nd]. 21p. Dep. NTIS.

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

The status and future possibilities for several alternates to the cyclotron for heavy-ion acceleration are discussed. Linear accelerators, both conventional and superconducting, tandem electrostatic accelerators, and the electron ring accelerator are among the accelerator types and concepts reviewed and compared. (27 references) (auth)

56796 (LA–5018) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending July 31, 1972. Dunn, Eleanor (comp.) (Los Alamos Scientific Lab., N. Mex.). Sep 1972. Contract W-7405-eng-36. 45p. Dep. NTIS.

The achievement of an 800-MeV proton beam at LAMPF on June 9, 1972, is announced. A summary of the work performed and the progress obtained is presented. Topics include engineering support, accelerator systems development, electronic instrumentation and computer systems, accelerator operations, experimental area, LAMPF facility construction, physics research, practical applications of LAMPF, and the LAMPF users group. (W.H.K.)

56797 (NAL–65) MONTHLY REPORT OF ACTIVITIES, NOVEMBER 30, 1971. (National Accelerator Lab., Batavia, Ill.). 1971. Contract AT(49-8)-3000. 10p. Dep. NTIS.

The status of the injection, the main ring, and the neutrino laboratory is outlined. (W.H.K.)

56798 (NAL–66) MONTHLY REPORT OF ACTIVITIES, DECEMBER 31, 1971. (National Accelerator Lab., Batavia, Ill.). 1971. Contract AT(49-8)-3000. 13p. Dep. NTIS.

The status of the main accelerator and the 30-in. bubble chamber is outlined, and a list of approved bubble chamber experiments is given. (W.H.K.)

56799 (NAL–67) MONTHLY REPORT OF ACTIVITIES, JANUARY 31, 1972. (National Accelerator Lab., Batavia, Ill.). 1972. Contract AT(49-8)-3000. 9p. Dep. NTIS.

The status of the accelerator and meson laboratory is summarized. (W.H.K.)

56800 (NAL–68) MONTHLY REPORT OF ACTIVITIES, FEBRUARY 30, 1972. (National Accelerator Lab., Batavia, Ill.). 1972. 11p. Dep. NTIS.

The achievement of the first 200-GeV proton beam at 1:08 p.m. on Feb. 30 is announced. Work on the magnet power supplies is briefly discussed, and the status of the proton laboratory is summarized. (W.H.K.)

56801 (NAL–69) MONTHLY REPORT OF ACTIVITIES, MARCH 31, 1972. (National Accelerator Lab., Batavia, Ill.). 1972. 9p. Dep. NTIS.

Work on the first experiment at NAL (Experiment #36 on the elastic scattering of protons at small angles) is briefly discussed. The status of the accelerator section and the proton switchyard is summarized. (W.H.K.)

56802 (NAL–70) MONTHLY REPORT OF ACTIVITIES, APRIL 30, 1972. (National Accelerator Lab., Batavia, Ill.). 1972. 8p. Dep. NTIS.

The status of the accelerator section, beam extraction from the main ring, and construction is summarized. (W.H.K.)

56803 (NAL–71) MONTHLY REPORT OF ACTIVITIES, MAY 31, 1972. (National Accelerator Lab., Batavia, Ill.). 1972. 9p. Dep. NTIS.

The status of the auditorium, accelerator development, and the water system is described. (W.H.K.)

56804 (NAL–72) MONTHLY REPORT OF ACTIVITIES, JUNE 30, 1972. (National Accelerator Lab., Batavia, Ill.). 1972. 9p. Dep. NTIS.

Work on accelerator improvement is outlined; and the status of experiments, the 30-in. bubble chamber, and the 15-ft bubble chamber is summarized. (W.H.K.)

56805 (NAL–73) MONTHLY REPORT OF ACTIVITIES, JULY 31, 1972. (National Accelerator Lab., Batavia, Ill.). 1972. 10p. Dep. NTIS.

The achievement of a 300-GeV proton beam a little after 9 p.m. on July 16 is announced. The status of accelerator development and experiments is outlined, and a ten-day shutdown to transfer the booster control system from a Sigma 2 to a Sigma 3 system is announced. (W.H.K.)

56806 NAL–74) MONTHLY REPORT OF ACTIVITIES, AUGUST 31, 1972. (National Accelerator Lab., Batavia, Ill.). 1972. 10p. Dep. NTIS.

The development and improvements on the main accelerator, the linac, the booster, and the injection system, extraction system, and the switchyard are summarized. The status of the 30-in. bubble chamber and the 15-ft bubble chamber is outlined. Also, a list of approved experiments is given. (W.H.K.)

56807 (UCRL-Trans–1478) THEORETICAL AND EXPERIMENTAL RESEARCH ON PLASMA METHODS OF ACCELERATION. Berezin, A. K. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). Translated for Univ. of California, Lawrence Berkeley Lab., Berkeley, from report KHFTI–72-7. 31p. Dep. NTIS.

The results of theoretical and experimental studies on the excitation of regular accelerating fields in the interaction of relativistic and nonrelativistic beams of charged particles with plasma are considered as well as acceleration of electrons by the field of slow waves of a plasma waveguide, these waves being excited by an external generator. (36 references) (auth)

56808 MICROTRON FOR SCIENTIFIC AND INDUSTRIAL APPLICATIONS. Atovm'yan, A. E.; Girshov, V. B.; Zhulinskii, S. F.; (and others). At. Energ. (USSR); 33: No. 2, 687-90(Aug 1972). (In Russian).

The basic characteristics and design features of a microtron having 32 orbits and an energy from 11 to 25 MeV are presented. Two interchangeable resonators for two modes of acceleration are used. The power of the accelerated electron beam is 0.35 kW at 14 MeV and 0.5 kW at 20 MeV. The working vacuum (10^{-5} to 10^{-6} torr) is provided by an electric-discharge titanium pump. The radio-frequency generator consists of a tunable magnetron in the 10-cm range having a pulse power of 1.8 MW. The pulse duration of the beam current is 2.5 μs and the pulse-repetition rate 50, 100, 200 and 400 Hz. The electron beam is extracted from the last two orbits. (6 figures, 4 references). (auth)

56809 ELECTRON LINEAR ACCELERATOR AT THE INSTITUTE OF NUCLEAR RESEARCH. Zimek, Z. (Inst. of Nuclear Research, Warsaw); Kolyga, S.; Levin, V.; (and others). Nukleonika; 17: No. 1-2, 75-85(1972). (In Russian).

A brief description of the electron linear accelerator at the Institute of Nuclear Research (INR) in Warsaw is presented. The accelerator was designed and produced in the Soviet Union according to the technical requirements prepared by the staff of the Department of Radiation Chemistry at the INR. Some design features connected with formation, acceleration, and output of the electron beam, whose current during the pulse exceeds 1 A, are described. The data of the electron beam, including its power, diameter, energy, and range of regulation, characteristics of its spectrum, etc., are given. Agreement between the calculated and experimentally obtained data was obtained. The collected experimental evidence indicates that technical and running parameters of the accelerator allow use of this machine for both research and radiation processing on a semitechnical scale. (8 figures) (auth)

56810 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR BOMBARDING A TARGET WITH IONS. Freeman, James Harry (to United Kingdom Atomic Energy Authority). British Patent 1,280,013. 5 Jul 1972. Filed 5 Sep 1969.

Apparatus for ion bombardment is described comprising an ion beam source, a magnet for deflecting the ion beam towards a window, means for stabilizing the ion beam to maintain the current passing through the window substantially constant, and a target holder behind the window with drive means for imparting controlled movement for scanning purposes. The target holder may be adapted to carry a number of targets in a row, or in a number of rows, the targets being moved in succession at controlled speed past the window. The drive means preferably reciprocate the target holder, the targets being moved repeatedly past the window and the total ion dose being determined by the number of reciprocations. Various window widths can be employed to suit various ions, and various geometries of window and target holders are described. Means are preferably provided for modulating the energy of the ion beam so that the deflection produced by the magnet correspondingly varies, causing the deflected ion beam to sweep backwards and forwards over the window. The ion beam is preferably produced by an ion beam separator. The means for modulation may comprise an electrical source arranged to superimpose an ac voltage upon a high dc voltage supplied to an accelerating electrode of the ion beam source. (UK)

56811 SOME DESIGN FEATURES OF PELLETRON ELECTROSTATIC ACCELERATORS. Battleson, K.; Herb, R. G. pp 231-41 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

56812 MEASUREMENTS OF THE CHARGE DISTRIBUTION IN THE EXTERNAL PARTICLE BEAM OF THE HAMBURG ISOCHRONOUS CYCLOTRON. Kellerman, H.-J.; Klages, H. O.; Krause, H.; Langkau, R.; Lau, K.-H. (Univ., Hamburg). Nucl. Instrum. Methods; 104: No. 1, 1-3(1972). (In German).

The distribution of the charges contained in the individual beam pulses of the external beam of the Hamburg Isochronous Cyclotron was studied. (6 figures) (auth)

Auxiliaries and Components

56813 (LA-5028) PROGRAMMER'S GUIDE TO THE MICROPROGRAMMED BRANCH DRIVER FOR THE PDP-11. Bevington, Philip R. (Los Alamos Scientific Lab., N. Mex.). Sep 1972. Contract W-7405-eng-36. 14p. Dep. NTIS.

The Microprogrammed Branch Driver (MBD) for the PDP-11 computer originally designed by Buchanan and Jones and since developed further by Biswell and Rajala for the requirements of LAMPF has been described in some detail from the hardware point of view. An outline that categorizes and describes the various components and instructions from the programmer's point of view to facilitate an understanding of the coding necessary for both the MBD processor and its associated PDP-11 computer is given. Stand-alone operation of the MBD is not covered. The version of MBD described is the LAMPF Mark II model; some of the mnemonics have been changed from their original definitions for consistency and compatibility with PDP-11 software. (auth)

56814 ROTATING PROBES FOR THE ANALYSIS OF SPATIAL CURRENT DISTRIBUTIONS IN PARTICLE BEAMS. Vide, 27: No. 157, 34-6(Jan 1972). (In French).

Rotating probes are described. These probes enable the envelopes, current distributions, and beam centering in accelerators to be studied; they may be used for any charged-particle experiment. (France)

56815 CORONA STABILIZER FOR VAN DE GRAAFF ACCELERATORS. Takacs, J. (Oxford Univ.). Nucl. Instrum. Methods; 103: No. 3, 587-600(1972).

The corona stabilizer as used on the EN tandem is analyzed. The predicted limitations due to the time delay and dispersion of the charge carriers in high pressure gas are in good agreement with the measured performance figures. The two loop stabilizer is described with the auxiliary generating voltmeter stabilizer facilitating semi-automatic operation. The resolution of the system measured by using ^{28}Si(p,p)^{28}Si resonance was ±1 keV. Multiple breakdowns were prevented during operation and conditioning by the introduction of a protection circuit. The circuit design was based upon the analysis of the breakdown behavior of the generator and its stabilizer. The recorded behavior of the generator after total breakdown is in good agreement with the predicted performance. (auth)

56816 MEASUREMENT OF HARMONIC FIELD CONTENTS OF PULSED MAGNETS USING A STEPPING SEARCH COIL. Kobayashi, M. (National Lab. for High Energy Physics, Ohomachi, Japan); Yamashita, S. Nucl. Instrum. Methods; 103: No. 3, 493-500(1972).

A Fourier analysis method with a step-driving search coil was developed in order to obtain harmonic field contents of pulsed quadrupole magnets. A search coil was rotated step by step by a fixed step angle to the correct angular position with an accuracy of 1×10^{-3} degrees and the flux through the search coil was measured with an accuracy as high as 0.01%. The harmonic field content was obtained from a Fourier analysis of a set of fluxes measured at different positions of the search coil. For the step angle of one degree, the harmonic field content at the gap radius was obtained with an ambiguity in terms of $(B_n/B_2)_{R_g}$ from 6.5×10^{-7} for $n = 1$ up to 2.7×10^{-4} for $n = 10$. Choice of the step angle, reproducibility of measurement, the measuring accuracy, etc. are discussed. (auth)

56817 SHIELDING AGAINST MUONS IN HIGH-ENERGY PROTON ACCELERATORS. Gurentsov, V. I.; Kimel, L. R.; Salimov, O. N. (Moscow Engineering-Physics Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 50-5(1972). (In Russian).

Muon shielding in proton accelerators is treated, making allowance for Coulomb scattering of muons, energy losses by ionization and excitation of atoms, bremsstrahlung, direct pair formation, and nuclear interaction. Coefficients which were obtained from experimental data were used in the double differential distribution of pions in nuclear interactions. Shielding from muons was calculated for 1,000 GeV operation of an accelerator. Results obtained for a proton accelerator at an energy of 200 GeV were compared with values by other authors. (tr-auth)

56818 SHIELDING FOR ULTRARELATIVISTIC MUONS. Ladu, M. (Univ., Cagliari, Italy); Pelliccioni, M.; Picchi, P.; Roccella, M Nucl. Instrum. Methods; 104: No. 1, 5-10(1972).

The survival probability, $P_E(x)$, of a muon penetrating through a thickness x of material is calculated with the Monte Carlo method. For standard earth as shielding material, the values of $P_E(x)$ and range distribution, $R_E(x)$, are given for E = 100, 200, and 500 GeV. (6 figures) (auth)

56819 MATCHING OF HIGH-ENERGY PROTON LINAC STAGES. Bondarev, B. I.; Solov'ev, L. Yu. At. Energ. (USSR); 32: No. 1, 79-81(Jan 1972). (In Russian).

In a linear proton accelerator where particle energies of 100 to 200 MeV are attained, there occurs a transition to the smaller wave length of the accelerator. As a means of matching sections a resonator is introduced between two portions of the accelerator; this resonator operates at the frequency of the long-wave-length portion. The performance of this resonator is discussed theoretically, and the suggestion is made that the principle may be employed wherever the need arises for a linear phase transformation of space clusters. (2 figures) (K.S.W.)

Ion Sources, Injection, and Extraction

56820 (ITEF-874) MEASUREMENT OF BEAM EMITTANCE IN THE VACUUM CHAMBER OF THE PROTON SYNCHROTRON OF THE ITEF. Nikolaev, V. I.; Koshkarev, D. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1971. 23p. (In Russian). Dep. NTIS (U. S. Sales Only).

The method for the measurement of the phase density of the proton beam injected into the chamber of the circular accelerator is described. Comparative data are presented on the measurement of the phase density of the injector yield (linear accelerator I-2) and directly in the circular chamber of the proton synchrotron. The method is described and the results of the measurement of the emittance through the rounded congruent beam are reported. It was shown that the real value of the Floquet function can be somewhat distinguished from the calculated values by approximation to the region of the parametric resonance. (tr-auth)

56821 (JINR-P9-6600) RESONANCE $Q_r = 1$ IN COLLECTIVE ACCELERATORS. Perel'shtein, E. A.; Perskii, M. S.; Shevtsov, V. F. (Joint Inst. for Nuclear Research, Dubna (USSR). 1972. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

The crossing of the entire and the parametric resonances of radial oscillations in an electron ring during an injection of its ions was examined. The increase in the amplitude in the parametric resonance was analyzed as a function of the rate of intersection. The effect of linearity of the intrinsic forces on the crossing of the total resonance was investigated. (tr-auth)

56822 IMPROVED GUN FOR PARTICLE ACCELERATORS. Leboutet, Hubert; Bensussan, Andre (to Thomson-CSF). French Patent 2,088,883. 7 Jan 1972. Filed 28 Apr 1970. (In French).

A very fast pulse gun for hf linear accelerators is presented. The source emitting the particles is connected to one side of an ht supply. A series of resonant cavities provided with orifices for the passage of the particles emitted from the source is connected to the other side of the ht supply. At least two adjacent cavities are tuned to sub-multiples of the high frequency, one of these two frequencies being an odd multiple of the other. (France)

56823 IMPROVEMENTS IN OR RELATING TO ION BEAM SOURCES. Freeman, James Harry (to United Kingdom Atomic Energy Authority). British Patent 1,280,012. 5 Jul 1972. Filed 5 Feb 1969.

Reference is made to ion beam separators. The separator described comprises an evacuated enclosure, means for generating ions in the enclosure and for ejecting the ions in a beam. The enclosure is adapted for vacuum tight attachment to an enclosed beam passageway in such a manner as to permit pivotal movement of the enclosure about a point coincident with the origin, or apparent origin, of the ion beam, so as to adjust the relative inclination of the ejected beam to the passageway. The ion beam will usually emerge from an extraction slit, and it is then important that adjusting movement of the enclosure should not give rise to lateral movement of the slit; the notional pivot of the enclosure should then be arranged to coincide with the extraction slit. The enclosure is preferably attached to the beam passageway through a vacuum bellows. Spherically machined and relatively slidable surfaces may conveniently provide the constraint on the adjusting movement of the enclosure. Alternatively, the enclosure may be mounted on gimbals for permitting the required limited movement. (UK)

56824 CRITICAL STUDY OF EMITTANCE MEASUREMENTS OF INTENSE LOW-ENERGY PROTON BEAMS. Evans, L. R.; Warner, D. J. (CERN, Geneva). Nucl. Instrum. Methods; 104: No. 1, 61-70(1972).

The measurement of emittance in low-energy proton beams suffers from two perturbing effects: the neutralization of the beam by backstreaming secondary electrons and the space charge blowup of the beam sample between defining and analyzing apparatus. An experimental study shows a significant change of the emittance orientation when bias is used to eliminate the secondary electrons. Biased and nonbiased cases are also compared with computed dynamics including space charge. Criteria for the slit size and drift distance which make the space charge blowup negligible are derived. In addition, a transverse coherent oscillation of the proton beam, which was revealed during the measurements, is discussed briefly. (8 figures, 2 tables) (auth)

Ion Optics and Field Calculations

Refer also to abstract 57298.

56825 (LBL-951) USER GUIDE FOR LBL TELETYPE AND VISTA TRANSPORT. Paul, A. C. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1972. Contract W-7405-eng-48. 47p. Dep. NTIS.

LBL's version of the ion optic code TRANSPORT for designing charged particle beam transport systems is available from the data cell and can be run interactively from a remote teletype terminal or a remote teletype and vista console. (auth)

56826 (NAL-64) TURTLE (TRACE UNLIMITED RAYS THROUGH LUMPED ELEMENTS): A COMPUTER PROGRAM FOR SIMULATING CHARGED PARTICLE BEAM TRANSPORT SYSTEMS. Carey, David C. (National Accelerator Lab., Batavia, Ill.). Dec 1971. Contract AT(49-8)-3000. 47p. Dep. NTIS.

TURTLE is a computer program designed to simulate charged particle beam transport systems. It allows evaluation of the effect of aberrations which exist in beams with small phase space volume. These include higher order chromatic aberrations, effects of non-linearities in magnetic fields, and higher order geometric aberrations due to the accumulation of second order effects. The beam at any point in the system may be represented by one and two-dimensional histograms. (auth)

56827 MULTIPOLE ELEMENTS FOR THE CORRECTION OF IMAGE ABERRATIONS. Wollnik, H. (Justus Leibig Univ., Giessen, Ger.). Nucl. Instrum. Methods; 103: No. 3, 479-84(1972).

Multipole elements are discussed as far as their properties of correcting image aberrations are concerned. Limitations of their use are explained. A method of producing multipole elements in a simple but very precise manner is given which employs the technique of etching thin copper foils similarly as for electronic circuits. (auth)

56828 ROTATION OF THE VERTICAL POLARIZATION OF A CIRCULATING ELECTRON BEAM INTO THE HORIZONTAL PLANE BY EXCITATION OF AN IMPERFECTION RESONANCE. Letardi, T.; Turrin, A. (CNEN, Frascati, Italy). Nucl. Instrum. Methods; 103: No. 3, 485-91(1972).

It is shown, theoretically, that the vertical polarization of a circulating beam in a synchrotron can be turned into the horizontal plane at an energy corresponding to an imperfection resonance of the magnetic moment motion. The evolution in time of the polarization vector is investigated under the circumstance when radiation loss causes the electrons to approach the resonance energy while spiraling into a suitable forcing perturbation. Particular attention is given to maintaining the spin motion essentially unchanged before the particles leave the phase stable position. It is expected that the spilled beam will have, at the resonance radius and at each azimuthal location, a known direction of polarization. The possibility of using such a method on the Frascati 1 GeV Constant Gradient Electron Synchrotron is considered, and shown to be worth trying. (auth)

56829 PARTICLE TRAJECTORIES IN A TOROIDAL CONDENSER CALCULATED IN A THIRD ORDER APPROXIMATION. Matsuo, T.; Matsuda, H.; Wollnik, H. (Osaka Univ.). Nucl. Instrum. Methods; 103: No. 3, 515-32(1972).

Radial particle trajectories in a toroidal condenser are calculated in a third order approximation and presented in the form of a transfer matrix. Together with the field calculations performed recently, the derived results should make it possible to determine image aberrations of third order for electrostatic sector fields. The potential distribution in the condenser is assumed to come from perfect toroidal electrodes. All formulas are written in a manner that is especially suitable for numerical computer calculations. (auth)

56830 MAGNETIC FOCUSING OF A RELATIVISTIC ELECTRON BEAM: THEORY. Freeman, J. R.; Poukey, J. W. (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys.; 43: No. 10, 4010-13(Oct 1972).

Computer-simulation techniques were used to study the interaction of a relativistic electron beam and a mirror magnetic field. A charge-neutralized steady-state model with self-consistent magnetic fields was used to simulate the drift-tube region. Comparisons are made between experimental results, adiabatic calculations, and the computer simulation for the electron distribution at the peak of the mirror field. The dependence of these results on the mirror ratio and beam-entrance conditions is presented. (7 figures) (auth)

56831 CYCLOTRON RESONANCE INTERACTION. Lindsay, P. A. (King's Coll., London). Int. J. Electron.; 33: No. 3, 289-310(Sep 1972).

A new method of approach to the old problem of interaction between an electron beam and an electromagnetic field is presented. It is shown that great simplification can be achieved by directly setting up a differential equation describing the flow of energy between the beam and the field; this obviates the necessity of an explicit calculation of the electron trajectories. A non-linear treatment of the cyclotron resonance interaction is used as an example of the inherent power and relative simplicity of the method. (auth)

56832 PRINCIPLES OF ION OPTICS AS APPLIED TO THE DESIGN OF A BEAM TRANSPORTING SYSTEM. Bakewicz, Edmund; Rogalska, Zofia (Instytut Fizyki Jadrowej, Krakow). Postepy Fiz.; 23: No. 3, 291-307(1972). (In Polish).

A short introduction to the principles of ion optics is given. As an example of the application of these principles the determination of the properties of the alpha particle beam extracted from the Cracow cyclotron U-120 is described, as well as the design of a beam transport system serving the five experimental positions. (10 figures) (auth)

56833 MECHANISM OF ACCELERATION OF HEAVY CHARGED PARTICLES. Kul'kin, A. G.; Loskutov, Yu. M.; Pavlenko, Yu. G. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 30-3(1972). (In Russian).

A law of motion was found for charged particles in a varying magnetic field. The parametric interaction of the magnetic field may be used for accelerating heavy charged particles. (tr-auth)

56834 ATTENUATION OF BETATRON OSCILLATIONS IN A WEAK-FOCUSING MAGNETIC FIELD. Zhukovskii, V. Ch.; Sokolov, A. A.; Shishanin, O. E. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 90-5(1972). (In Russian).

The attenuation of radial and vertical oscillations of electrons in a weakly-focusing magnetic field of an accelerator was considered, in which the attenuation was assumed to affect reaction of synchrotron radiation. Corresponding decrements of attenuation were computed by the quantum mechanical method. (tr-auth)

56835 ELECTROSTATIC SELF-FOCUSING OF ELECTRON STREAMS. McCorkle, R. A. (Univ. of East Carolina, Greenville, N. C.); Bennett, W. H. J. Phys., A (London); 5: No. 4, 524-33(Apr 1972).

The electrostatic self-focusing mechanism for electron streams is shown to be a stronger focusing process than previously realized in that most of the potential drop that obtains between the stream axis and the surrounding tube wall occurs in a rapid potential variation in and near the stream itself. Streams are self-focusing when the particles have transverse energy spreads less than a well defined value that depends on the stream particle energy and the choice of ambient gas. The stream diameter is inversely proportional to the current for low values of stream perveance, but is independent of the current for high values of this parameter. The average random energy of the ambient electrons is high in the stream vicinity as compared with values near the tube wall. (auth)

Storage Rings

56836 (BNL-17072) PHASE SPACE INTERCHANGE IN THE AGS-ISA TRANSFER. Brown, H. N. (Brookhaven National Lab., Upton, N. Y.). 12 Jul 1972. 6p. Dep. NTIS.

As noted in the Preliminary Design Study for ISABELLE, the horizontal aperture requirement is much more stringent than the vertical due to the allowance for synchrotron phase oscillations. For this reason, it is suggested in the report that the vertical phase space emitted by the AGS, which is only 0.4 π μrad-m, be interchanged with the larger horizontal AGS emittance, 3.0 π μrad-m. To do this, a section of quadrupoles, rotated 45° about their axes, was proposed. The way in which the quadrupole requirements may be found is discussed, and an example is given. (W.H.K.)

56837 (BNL-17079) THERMAL CONTRACTION OF A LAMINATED MAGNET WELDED WITH STAINLESS-STEEL TIE-BARS. Lasky, C. (Brookhaven National Lab., Upton, N. Y.). 3 Aug 1972. 8p. Dep. NTIS.

Thermal contractions of model superconducting magnet cores welded with stainless-steel tie-rods are described. (auth)

56838 (BNL-17091) BACKGROUND RATES IN A 4π DETECTOR AT ISABELLE. Friedberg, Carl (Brookhaven National Lab., Upton, N. Y.). 10 Aug 1972. 2p. Dep. NTIS.

The large background of real p + p events which might prevent complete reconstruction using any proposed 4π solid angle detector at ISABELLE requiring maximum available luminosity is briefly discussed. (W.H.K.)

56839 (BNL-17107) COS 2 Θ QUADRUPOLE OF 8-CM APERTURE. Dahl, P. F.; Morgan, G. H.; Sampson, W. B. (Brookhaven National Lab., Upton, N. Y.). 11 Aug 1972. 5p. Dep. NTIS.

A conductor distribution for an 8-cm i.d. cos 2θ superconducting ribbon-wound quadrupole model magnet appropriate for ISABELLE is proposed and the expected field gradient, peak field, and harmonic components are indicated. (auth)

56840 (BNL-17108) ISABELLE BEAM STOP PROBLEMS. Moore, W. H. (Brookhaven National Lab., Upton, N. Y.). 24 Jul 1972. 22p. Dep. NTIS.

The "Preliminary Design Study" for ISABELLE briefly discusses some problems related to the instantaneous dumping of 10^{15} 200-GeV protons into a beam stop. The high energy density within the interaction volume of the beam stop material elevates the temperature to a level where serious ablation will occur even if such a highly refractory material as graphite is considered. Efforts to increase the interaction volume (thus decrease the energy density) were not convincingly developed in the design study. A proposal to dump the external proton beam pulse into a tank of water is examined and seems to be satisfactory and economical. Another problem, omitted in the design study, pertains to the extraction of the beam pulse from vacuum to air through a suitable window ahead of the beam stop. The thermal phenomena associated with the window design is considered in detail with the consequence that, although they are severe, a window design is possible. (auth)

56841 (BNL-17138) COIL CONFIGURATIONS IN SUPERCONDUCTING DIPOLES. Parzen, G.; Jellett, K. (Brookhaven National Lab., Upton, N. Y.). 15 Apr 1972. 12p. Dep. NTIS.

The limitations on the good field aperture of superconducting dipoles due to approximating the cos θ current distribution using a finite number of ribbon-shaped conductors arranged in blocks is investigated. Results are presented for the good field aperture limit due to the choice of the number of blocks per quadrant. Results are also presented for several ribbon configurations having 5, 6, and 7 blocks per quadrant, for which the lower undesired multipoles are eliminated by using either slight azimuthal displacements of the block or special multipole correction windings. (auth)

56842 (BNL-17143) THOUGHTS ON STORAGE RING BY-PASS. Teng, L. C. (Brookhaven National Lab., Upton, N. Y.). 21 Aug 1972. 5p. Dep. NTIS.

The statement that by-passes in a storage ring, namely putting interaction straight sections in parallel instead of in series, will improve the flexibility, and thereby increase the experimental output is discussed. It is decided that by-passes should not be contemplated for ISABELLE. (auth)

Experimental Facilities

56843 (BNL-17093) REVISED DESIGN OF LARGE ANGLE PROTON-PROTON ELASTIC SCATTERING FOR ISABELLE. Orear, Jay (Brookhaven National Lab., Upton, N. Y.). 26 Jul 1972. 6p. Dep. NTIS.

The experimental layout including the beam focusing elements and the detector system for study of large angle p + p elastic scattering at ISABELLE is briefly described. (W.H.K.)

56844 (BNL-17154) VALUE OF MEASURING SINGLE PARTICLE INCLUSIVE CROSS SECTIONS AT 90° IN THE ISABELLE CM FRAME. Slattery, P. (Brookhaven National Lab., Upton, N. Y.). 1 Sep 1972. 6p. Dep. NTIS.

An argument is given for an experimental program to measure the single particle inclusive cross sections at 90° in the ISABELLE cm frame which will be implemented early in the operation of the storage rings. (W.H.K.)

56845 (ITEF-875) AN AUTOMATED ASSEMBLY FOR MEASURING ANGULAR ANISOTROPY OF POLARIZED β-ACTIVE NUCLEI. Bulgakov, M. I.; Gul'ko, A. D.; Oratovskii, Yu. A.; Trostin, S. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1971. 29p. (In Russian). Dep. NTIS (U. S. Sales Only).

An assembly, designed for measurement with time of the angle of the anisotropy of the radiation of polarized β-active nuclei, produced by means of the capture of polarized thermal neutrons by nonpolarized target nuclei, is described. The size of the anisotropy was proportional to the degree of polarization of the radioactive nuclei. The assembly made it possible to study nuclei, having decay periods in the interval from 0.01 sec to 30 min. and to investigate the change of the angle of the 0-II anisotropy (i.e., polarized nuclei) with time. A block scheme of the assembly, an auxiliary diagram of its operation, and schemes of some functional elements were also presented. (tr-auth)

56846 (MATT-923) FUSION NEUTRON SOURCES INDUCED BY NEUTRON INTERACTIONS. Greenspan, E. (Princeton Univ., N. J. Plasma Physics Lab.). Sep 1972. Contract AT(11-1)-3073. 11p. Dep. NTIS.

The potential of neutron-nucleus interactions to provide sources of 14 MeV neutrons for radiation damage experiments is investigated. Two types of neutron interactions are considered: absorption reactions in LiD converters, and elastic scattering collisions in DTO converters. Several combinations of neutron source-converter systems are evaluated. The driving neutron sources include localized sources and fission reactors. It is estimated that the strength of the 14 MeV sources attainable in fission reactors can be as high as 10^{12} and 10^{13} n/sec/MW with LiD and DTO converters, respectively. The neutron fluxes provided by these systems can be, however, of the order of 10^{11} n/cm^2 sec only. These fluxes are too low for high-fluence radiation damage studies. (auth)

56847 (SC-T-722545) PREPARATION AND OPERATION OF METAL HYDRIDE NEUTRON-PRODUCING TARGETS. Detaint, Jacques (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Translation of report CEA-R-4212. 186p. Dep. NTIS.

Thesis. Submitted to Univ. of Grenoble, France.

Physicochemical phenomena associated with the bombardment of metals with hydrogen ions and the implantation of these ions into their hydrides were studied (sputtering, spatial distribution of stopped deuterons, hydrogen diffusion, gas bubble formation, etc.). The time dependence of the neutron yield was studied with self-loading targets and prehydrogenated targets; a simple theory concerning the half-lives of tritiated targets was developed. A new type of target is proposed which has a longer lifetime: the diffusion barrier target. The method of manufacture is discussed, and a new apparatus constructed for its preparation is described. It includes an electron gun evaporator for depositing thin metallic films (Ti, Y, Zr, Er . . .) under ultrahigh vacuum and a reaction furnace into which the films are placed under vacuum and in which their hydrides are formed. (France)

56848 FOUR-METER LONG SUPERCONDUCTING MAGNETIC FLUX EXCLUSION TUBE FOR PARTICLE PHYSICS EXPERIMENTS. Martin, F.; St. Lorant, S. J.; Toner, W. T. (Stanford Univ., Calif.). Nucl. Instrum. Methods; 103: No. 3, 503-14(1972).

The design and construction of a field-free channel through the transverse central magnetic field of a 54 inch aperture magnet is described. This flux-free path is an essential part of an experiment at the Stanford Linear Accelerator Center to measure the electron production of neutral rho mesons. The flux exclusion tube itself is made of Nb_3Sn tape bonded with lead—tin solder to form a rigid tube of laminated superconducting material, approximately four meters long and from 6 to 25 mm in diameter. The transverse magnetic field shielded exceeds 1.5 T. The performance of the tube and its associated cryostat is discussed. (auth)

56849 MAGNETIC FOCUSING OF A RELATIVISTIC ELECTRON BEAM: EXPERIMENT. Bolduc, P. E.; Patterson, E. L. (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys.; 43: No. 10, 4006-10(Oct 1972).

A magnetic mirror is used to control and focus a 2.0-MeV 70-kA electron beam. Mirror ratios of 3.7 and 5.9 and magnetic fields of 2.0, 2.5, and 5.0 kG are used. A 500-μ air pressure is used in the drift tube to minimize the one electrostatic and magnetic self-forces of the beam. The surface-energy deposition in a sample placed at the peak of the 3.7 to 1 bottle is approximately twice as large as that obtained with beam self-focusing without an external field. The fluence and energy as a function of axial position in the region of low grad B_z agree with the results of adiabatic theory, and are found to be independent of magnetic field strength and nearly independent of mirror ratio for the selected ranges. Reproducibility in delivered energy, fluence, and surface-energy deposition is significantly greater than that obtained without an external magnetic field. The induced B_z field due to beam rotation or plasma diamagnetism is approximately 1% of the applied field. (5 figures) (auth)

56850 USE OF LINEAR ACCELERATORS FOR GAMMA RADIOGRAPHY. Poulard, S. (CEN de Saclay, Gif-sur-Yvette, France). Non-Destruct. Test.; 5: No. 5, 303-6(Sep 1972).

The use of linear accelerators for radiography for ndt is still in its infancy. The operation of linear accelerators is described from the point of view of gamma radiography. The working parameters and limits are discussed. Installations in operation in France are described, and it is proposed that hiring the facilities out by the beam-hour would best serve the development of this method of gamma radiography. (auth)

56851 ACCELERATOR TRAGETS FOR THE PRODUCTION OF NEUTRONS. Guillaume, M.; Peters, J. M.; Winand, L.; (and others) (to EURATOM). Canadian Patent 896,622. 28 Mar 1972. Priority date 18 Jun 1965, Belgium. (In French).

A procedure is described for the fabrication of targets suitable for use in accelerator production of neutrons. A layer of a polymer, prepared from monomer containing deuterium or tritium, preferably benzene, and powdered, is applied to a metal disc under high pressure. If desired, the polymer, in a powder, can be mixed with BeO in a proportion of 4 : 1 by weight and compressed on the disc. The adhesion of the polymer to the disc can be improved by covering the disc with a layer of silver. (Canada)

56852 COMPUTER SYSTEM OF THE HARWELL SYNCHROCYCLOTRON GROUP. Whitehead, C.; Jarvis, O. N.; Langsford, A. (United Kingdom Atomic Energy Authority, Harwell, Eng.). CAMAC Bull.; No. 4, 18-19(July 1972).

A direct-access multi-user system (DAMUSC) allows data collection from several independent nuclear physics experiments, through use of a single central computer and multiprogramming techniques. The experiments are interfaced through CAMAC in each of the remote counting rooms. These CAMAC crates are connected to a CAMAC system-crate in the computer room by parallel highways. User programs are supported by OLERT—an-on-line real-time executive with user-coded modifications to take account of CAMAC hardware and the extensive use of magnetic tapes. (EURATOM)

56853 ELECTRON IRRADIATION APPARATUS. Emanuelson, Roy M.; Cram, Robert D. (to High Voltage Engineering Corp.). British Patent 1,282,122. 19 Jul 1972. Filed 13 Oct 1969.

Reference is made to apparatus for electron irradiation of goods which mitigates radiation hazards to operating personnel, without involving the provision of the usual costly safety features such as radiation-proof vaults and interlock systems. The apparatus described comprises an enclosed evacuated chamber, with means for producing a beam of high energy electrons along the axis. Scanner means are provided for expanding the beam to form an elongate fan-like configuration, together with a beam-emitting window, and transport means for the goods to be irradiated. The transport means are provided with integral shielding sufficient to attenuate generated x-rays to below 2.5 mR/hr under normal operating conditions and with interlocking so that removal of any of the units of the transport means interrupts the beam. The transport means may comprise a conveyor having movable mechanical obstructions positioned to permit goods to pass through, under the beam, while blocking passage of personnel. These obstructions may comprise lead filled steel rollers. The system is such that costly exterior vaulting is not required, and the complexity of automatic equipment is greatly reduced or entirely eliminated. Ready loading and unloading are possible without radiation danger to personnel. The apparatus can be arranged for "fail-safe" operation. Various designs of transport means are described. (UK)

56854 PARTICLE—GAMMA COINCIDENCE EXPERIMENTS AT THE SACLAY 16 MeV TANDEM LABORATORY. Ballini, R.; Beuzit, P.; Delaunay, J.; (and others) (CEN, Saclay, France). pp 243-4 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna, Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 55665, 55739, 56940, 57063, 57217, 57228, 57243, 57244, and 57392.

56855 (AECL—4264) COSMIC RAY NM—64 NEUTRON MONITOR DATA. XXI. Monthly Graphs, January—April 1972. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jun 1972. 62p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

Uncorrected and barometer-corrected results from the cosmic-ray stations in Canada using equipment maintained by AECL are given in tabular form for the period from January to April 1972. Normalized graphs are given for the same period. Correction factors for the constant rates of drift of the barometers at each of the four stations are given. (auth)

56856 (HASL—263) TABLES OF TYPE NM-64 COSMIC-RAY NEUTRON MONITOR COUNTING RATES AS A FUNCTION OF THE SOLAR MODULATION OF GALACTIC COSMIC RAYS EXPRESSED IN TERMS OF THE EHMERT POTENTIAL. O'Brien, Keran; de P. Burke, Gail (Health and Safety Lab. (AEC), New York). Aug 1972. 111p. Dep. NTIS.

Calculated tables of type Nm-64 cosmic-ray neutron-monitor counting rates as a function of solar activity are given in terms of the potential of the force-field approximation to solar modulation of galactic cosmic rays. The tables are at intervals of one MV from complete demodulation (0 MV) to an extreme maximum of 1000 MV. (auth)

56857 SEARCH FOR ANTIHELIUM IN PRIMARY COSMIC RADIATION. Evenson, Paul (Univ. of Chicago). Astrophys. J.; 176: No. 3, 797-808(15 Sep 1972).

A search for anti-α particles in the primary cosmic radiation was carried out, and a new upper limit for these particles in the range 0.2 to 4.3 GeV/N was obtained. At the 95% confidence level the upper limit was found to be 0.14% of the α-particle flux. The instrument used for this purpose was a magnetic spectrometer employing spark chambers for determining particle trajectories and time-of-flight measurement for the rejection of upward-moving particles. Implications of these results for various models of the sources of cosmic radiation are discussed. (auth)

56858 ^{129}I AND ^{244}Pu ABUNDANCES IN WHITE INCLUSIONS OF THE ALLENDE METEORITE. Podosek, F. A. (California Inst. of Tech., Pasadena); Lewis, R. S. Earth Planet. Sci. Lett.; 15: No. 2, 101-9(Jun 1972).

Data are presented for thermal-release xenon analysis of a neutron-irradiated sample of white inclusions from the carbonaceous chondrite Allende. The best-fit high-temperature ^{129}Xe/^{132}Xe vs. ^{128}Xe/^{132}Xe isochron defines an iodine-xenon age 2.4 ± 1.3 my before that of the chondrite Bjurböle, well within the previously observed range of meteoritic iodine—xenon ages. The high-temperature data are not strictly consistent with the linear isochron model, however, and are best interpreted as defining a spread of about 4 my, corresponding either to slow cooling or to separate formation of phases before aggregation. The high-temperature data also define a good correlation between ^{130}Xe/^{132}Xe and ^{134}Xe/^{132}Xe, determining a ratio ^{244}Pu/^{238}U = 0.087 ± 0.011 at the time the sample began to retain xenon. This ratio is nearly six times higher than that found in the chondrite St. Severin. Comparison with the iodine chronology indicates that this result cannot be interpreted as very early gas retention, but must be ascribed to chemical fractionation between Pu and U in the formation of these inclusions. Results are also presented for a partial thermal-release xenon analysis of the neutron-irradiated carbonaceous chondrite Karoonda. Agreement of these results with those of a previous experiment is significant because Karoonda is the first case in which it has been possible to test the reproducibility of the I—Xe method by comparison of duplicate analyses. (auth)

56859 FLUXES OF STOPPING—MUONS UNDERGROUND. Bhat, P. N.; Murthy, P. V. Ramana (Inst. of Fundamental Research, Bombay). Lett. Nuovo Cim.; 4: No. 12, 543-9(22 Jul 1972).

A systematic investigation of the fluxes of cosmic muons which come to rest and decay at various depths underground is made to determine whether the stopping muon flux can be understood in terms of the known processes or if any new process of production is taking place. The value of the ratio of the flux of stopping to penetrating muons is given. The stopping muon fluxes are found to be $(2.62 \pm 0.15)10^{-4}$, $(8.16 \pm 0.4)10^{-6}$, and $(7.7 \pm 0.6)10^{-8}$ muons/cm^2s (sr) (hg cm^{-2}) at the surface and at depths of 96 and 417 hg/cm^2 from the top of the atmosphere, respectively. (J.F.P.)

56860 COSMOGENIC RADIONUCLIDES IN STONES AND METEORITE ORBITS. Lavrukhina, A. K.; Ustinova, G. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Earth Planet. Sci. Lett.; 15: No. 4, 347-60(Aug 1972).

Depth distributions of 14 cosmic-ray produced radionuclides in chrondrites and achondrites of different sizes were calculated. The dependence of depth distributions of different radionuclides on compositions and preatmospheric sizes of meteorites, on temporal and spatial variations of cosmic rays was investigated. There is an "orbital effect" in cosmogenic radionuclide accumulation owing to the limitation of the modulation range (the upper limit is a 1.9 AU from the Sun): in meteorites with large orbits the activities of radionuclides must be higher due to the bombardment of the meteorites by unmodulated cosmic rays during a part of their way. Thus, radionuclide activity can be a criterion for the sizes of meteorite orbits. According to the known meterorite orbits the following dependence for meteorites with aphelia more distant than 1.9 AU was derived: $q' = 1.25 + 0.13z + 0.53z^{-1}$ where q' is an aphelion in AU, $z = t_{mod}/t_{orb}$, t_{orb} is the flight time along the orbit, t_{mod} is the flight time in the modulation range. By analysing ^{26}Al activities in 44 hypersthene, 29 bronzite, 4 enstatite chrondrites, and 23 achondrites the aphelia of these stones were determined. The chondrite distribtuions vs aphelia had maxima between 1.9 and 2.5 AU. Therefore, as most chondrites have a semimajor axis $a \sim 1.5 - 1.7$ AU, one may suppose according to the model calculations of Anders and Mellick by the Monte Carlo method that chondrite parent bodies were asteroids of the Mars family (similar to 2 Pallas or 1310 Villigeria) or of the Apollo family (similar to 1685 Toro). Achondrites may have another origin. The proposed method for calculating the sizes of meteorite orbits combined with the method of visible radiants makes is possible to obtain all orbit parameters (a, e, i, q, q′) for the meteorites with known atmospheric trajectories. (auth)

56861 COMPLEX IRRADIATION HISTORY OF THE WESTON CHONDRITE. Schultz, L. (Swiss Federal Inst. of Tech., Zurich); Lorin, J. C.; Pellas, P. Earth Planet. Sci. Lett.; 15: No. 4, 403-10(Aug 1972).

Helium, neon, and argon were analysed in seven different light inclusions of the gas-rich chondrite Weston. Tracks produced by galactic cosmic rays were counted in some of these xenoliths. One of the xenoliths contains approximately 20% more spallogenic gases than the others. This gas excess is paralleled by a track excess and cannot be explained by a depth effect or by differences in the chemical composition. The explanation of the noble gas and track excess which accounts for all observations is an exposure of the particular xenolith to cosmic irradiation prior to compaction of the meteoroid. (auth)

56862 ABSENCE OF RAPID FLUCTUATIONS IN THE GROUND LEVEL γ-RAY BACKGROUND. James, A. N. (Univ. of Liverpool, Eng.). Nature (London) Phys. Sci.; 238: No. 84, 91-2(7 Aug 1972).

Periodic fluctuations in the γ-ray background have recently been reported, comprising an increase of one to two orders of magnitude over periods of the order of 1 sec. Using an apparatus designed to detect similar events at Liverpool University no such fluctuations were, however, observed. The conflicting findings are discussed, including the possibility of the events being associated with annihilation of antimatter dust grains near the Earth. The most likely place for annihilation to occur is high in the stratosphere. Concorde and other high-flying jets are possible experimental platforms for investigating this possibility. (UK)

56863 COSMIC ABUNDANCE OF IRON AND NATURE OF PRIMITIVE MATERIAL IN METEORITES. Kerridge, J. (Univ. of California, Los Angeles). Nature (London); 239: No. 5366, 44-5(1 Sep 1972).

It is stated that there are grounds for questioning the extent to which the complex Type I meteorites have remained closed systems since separation from the solar gas, and it is suggested that the apparent primitive chemistry of such a meteorite may be the result of a major component dominating the analysis and that this component might be unaltered solar system condensate. The main problem is concerned with inter-relations between magnetite, which comprises 10 to 15% by weight of the meteorite, and phyllosilicates, which occur as sub-microscopic chemically heterogeneous grains making up about 65% by weight. It is suggested that phyllosilicates, representing unaltered material, and magnetite, representing altered material, were mixed together at low temperature, presumably on the meteorite parent body, so that they never equilibrated with each other. It is concluded that existing data are compatible with the idea that the "primitive essence" of a Type I carbonaceous meteorite consists of its phyllosilicate population. This hypothesis, if correct, leads to a new value of $5.3 \pm 0.6 \times 10^5$ (relative to Si = 10^6) for the cosmic abundance of Fe, sensibly different from the commonly used bulk value of $9.0 \pm 0.5 \times 10^5$. The hypothesis that Type I phyllosilicates may be considered as the building blocks of the solar system can be tested experimentally. (UK)

56864 GAMMA RADIATION OF MAGELLANIC CLOUDS AND METAGALACTIC ORIGIN OF COSMIC RAYS. Ginzburg, V. L. (Lebedev Inst. of Physics, Moscow). Nature (London) Phys. Sci.; 239: No. 88, 8(4 Sep 1972).

It is considered that metagalactic models for the origin of the primary component of cosmic rays, observed near the Earth, are improbable, the principal arguments for this conclusion being connected with energetic considerations and data on the isotropic γ-ray background. These agreements are not, however, conclusive, particularly for local metagalactic models. It is believed that a strong argument in favor of galactic models is provided by preliminary data on the existence of a powerful source of primary cosmic rays close to the center of the Galaxy, and the possibility of solving the problem by measuring the γ-ray flux from the Magellanic Clouds is discussed. (UK)

56865 EXPOSURE AGE OF THE KIFFA METEORITE. Tobailem, Jacques; Lalou, Claude (CEN de Saclay, Gif-sur-Yvette). Compt. Rend., Ser. B; 274: No. 21, 1185-7(24 May 1972). (In French).

The activities of the ^{48}V, ^{54}Mn, ^{22}Na, ^{60}Co, ^{26}Al, and ^{40}K radionuclides found in the Kiffa meteorite (which fell the 23rd of October 1970) were determined by γ spectrometry. The age of the meteorite was determined from its ^{26}Al and ^{22}Na contents. This age was estimated to be about 2 million years. (France)

56866 UPPER LIMIT OF THE MEAN INTERACTION PATH IN AIR OF COSMIC PROTONS GENERATING EXTENSIVE SHOWERS. Catz, Philippe; Gawin, Jerzy; Hochart, Jean Pierre; Maze, Roland (CNRS, Verrieres-le-Buisson, France). Compt. Rend., Ser. B; 274: No. 22, 1253-6(29 May 1972). (In French).

The determination of the angular distributions of extensive showers as a function of their contents in penetrating particles enabled an upper limit to be established for the mean interaction path, Λ, in air for cosmic protons having energies in excess of 10^{14} eV. Λ^+ was determined to be 91 ± 3 g cm^{-2}. The hypothesis on showers containing abnormally small quantities of muons is confirmed. (France)

56867 MUON FLUX OF COSMIC RAYS AT SEA LEVEL. De, A. K.; Ghosh, P.; Mitra, S.; Bhattacharya, P. C.; Das, A. K. (University Coll. of Science, Calcutta). J. Phys., A (London); 5: No. 8, 1236-42(Aug 1972).

The sea-level absolute vertical integral cosmic-ray muon intensities for three momenta near 1 GeV/c at 12°N were measured with a range spectrometer. The results obtained from this measurement were used to derive the intensities at a latitude of 50°N by applying the latitude correction suggested by Olbert (1954). The integral muon intensities were found to be on the average 3.5% lower and 21.6% higher than the values obtained by Allkofer et al (1970, 1971) and Rossi (1948), respectively. The differential intensities derived from the integral ones were 20% higher than those calculated from Olbert at the same latitude. The results of the other recent measurements on the differential muon intensities in the low-energy region in relation to a proposed form spectrum are also discussed. (auth)

56868 NATURE OF THE LONG-TERM AND SHORT-TERM MODULATIONS OF COSMIC-RAY INTENSITY. Kane, R. P. (Physical Research Lab., Ahmedabad, India). J. Geophys. Res.; 77: No. 28, 5573-9(1 Oct 1972).

By combining the data from several neutron monitor stations expected to give similar results and using the monthly maximum values, a comparative study is made of the long-term variation of high-latitude and equatorial cosmic-ray intensities. It is confirmed that the modulation function is not constant but shows definite steplike changes, as was pointed out earlier by Carmichael and Stoker. It is suggested that the steplike changes may be associated with changes in the parameter r_B representing the extent of the modulating region. Forbush decreases are shown to have in general flatter spectra than the long-term modulation. (auth)

56869 STOPPING RATE OF NEGATIVE COSMIC-RAY MUONS NEAR SEA LEVEL. Spannagel, G.; Fireman, E. L. (Astrophysical Observatory, Cambridge, Mass.). J. Geophys. Res.; 77: No. 28, 5351-9(1 Oct 1972).

A production rate of 0.065 ± 0.003 ^{37}Ar atom/kg min of ^{39}K at a 2-mwe (meters water equivalent) depth below sea level was measured both by sweeping argon from potassium solutions and by counting argon that diffused from dry potassium acetate powder. This rate is unaffected by surrounding the solution with paraffin or by the presence of solution water, and it is attributed to negative-muon captures and the electromagnetic interaction of fast muons and not to a nucleonic cosmic-ray component. The ^{37}Ar yield from ^{39}K by the stopping of negative muons in a muon beam of the SREL synchrocyclotron was measured to be 8.5 ± 1.7%. The stopping rate of negative cosmic-ray muons at a 2-mwe depth below sea level from these measurements and from an estimated 17% electromagnetic production is 0.63 ± 0.13 μ^-/kg min. Previous measurements on the muon stopping rate vary by a factor of 5. The value is slightly higher but is consistent with two previous high values. The sensitivity of the ^{37}Ar radiochemical method for the detection of muons is considerably higher than that of the previous radiochemical methods, and the ^{37}Ar radiochemical method could be used to measure the negative-muon capture rates at great depths. (auth)

56870 STUDY OF THE NONIONIZING COMPONENT OF THE COSMIC RADIATION UNDERGROUND. Barton, J. C.; Pourgourides, C. M. (Polytechnic, London). J. Phys., A (London); 5: No. 5, 745-62(May 1972).

An efficient anticoincidence screen was designed and operated in an underground laboratory at a depth of 61 hg cm^{-2} below the surface. A series of experiments, using different types of counter inside this screen, were performed to study the properties of the underground nonionizing radiation at energies greater than 5 MeV. It was established that the leakage of muons through the screen was very small. The rate of neutron knock-on events was found to be 1.8 l^{-1}d^{-1} for protons of energy greater than 12 MeV. The rate of events due to photons of energy greater than 10 MeV was about 15 l^{-1}d^{-1}. The origin of these photons is discussed, and it is argued that most of them are due to the bremsstrahlung of electrons knocked on by muons. No evidence is found for any anomalous behavior of the cosmic radiation underground. (auth)

56871 ZENITH-ANGLE DEPENDENCE OF THE METEOROLOGICAL CORRECTION COEFFICIENTS FOR THE COSMIC-RAY HARD COMPONENT. Kavlakov, S. P.; Katsarski, L. M. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 4, 483-6(1972).

The dependence of Duperier coefficients on the zenith angle of cosmic muon registration is investigated. Duperier coefficients correlate cosmic-ray intensity data with corresponding data for meteorological data in the atmosphere. (L.T.W.)

56872 DIFFUSION PROCESSES OF COSMIC RAYS WITH ENERGIES BETWEEN 2 AND 20 GV DURING FORBUSH DECREASES: THE DIURNAL EFFECT. Bussoletti, E. (CNR, Rome); Geranios, A. Nuovo Cim.; 11B: No. 1, 53-67(11 Sep 1972).

A study of the morphology of the diurnal variation of the cosmic-ray intensity during the Forbush decreases in the periods 15 October 1965—30 June 1966 and 21 January 1967—17 December 1968 is presented in this article. Part of the data has been treated utilizing a new method of analysis of the equatorial anisotropy. Generally our results and those of other authors agree. An explanation for the changes observed in the phase of maximum T_M of the diurnal variation during the recovery of the Forbush decreases is given in terms of cosmic-ray diffusion processes. From these results a phenomenological model of the Forbush decrease is made which takes into consideration both a cosmic-ray input from the advancing shock front and a "solar" input due to the high density of scattering centers in the vicinity of the Sun. The different and peculiar trend of T_M observed during supposed "corotating type" events suggests the importance of this parameter as an "indirect" index for their identification when magnetic data are not available. In addition to the previous results, a study of the North—South anisotropy in connection with the magnetic parameters measured by Pioneer 8 has been performed. (auth)

56873 GAMMA RAYS ORIGINATING FROM THE CENTER OF THE GALAXY. Vedrenne, Gilbert (Univ., Toulouse). Sci. Progr. Decouverte; No. 3443, 32-41(Apr 1972). (In French).

A brief review of the results obtained in the detection of cosmic gamma radiation is given. The various hypotheses advanced about the interactions which might have led to the creation of such radiations are presented. (France)

56874 ANISOTROPY OF COSMIC RAYS OF GALACTIC ORIGIN ABOVE 10^{17} eV. Karakula, S.; Osborne, J. L.; Roberts, E.; Tkaczyk, W. (Univ. of Durham, Eng.). J. Phys., A (London); 5: No. 6, 904-15(Jun 1972).

By following the trajectories of protons in the Galaxy the detailed form of the anisotropy of ultrahigh-energy cosmic rays of galactic origin for given magnetic fields and source distributions is predicted. Three specific magnetic-field models based on interpretations of the observational data are used and sources uniformly distributed throughout the galactic disc or spiral arms, or concentrated at the galactic centre are considered. Data on the arrival directions of extensive air showers are then compared with the predicted distributions for these models, and assuming that metagalactic cosmic rays are isotropic, upper limits are given for the fraction of cosmic rays of galactic origin. (auth)

56875 IMPROVED MEASUREMENT OF THE CHARGE RATIO OF COSMIC RAY MUONS IN THE RANGE 10 TO 300 GeV/c. Ayre, C. A.; Hume, C. J.; Nandi, B. C.; (and others) (Univ. of Durham, Eng.). J. Phys., A (London); 5: No. 6, L53-6(Jun 1972).

The MARS instrument at Durham was used to study the charge ratio of near vertical cosmic-ray muons in the momentum range 10 to 300 GeV/c. No significant structure was seen and there was no firm evidence to favor a significant deviation from the mean value of 1.284 ± 0.004. Including the results from the Utah detector, which correspond to muon momenta in the range 1000 to 2000 GeV/c, there was the suggestion of near constancy from 10 GeV/c to 2000 GeV/c. (auth)

Stars

Refer also to abstracts 55739, 57290, and 57448.

56876 PROBABILISTIC FORMULATION OF THE NON-COHERENT-SCATTERING PROBLEM. Athay, R. Grant (National Center for Atmospheric Research, Boulder, Colo.). Astrophys. J.; 176: No. 3, 659-69(15 Sep 1972).

The noncoherent-scattering problem is formulated in terms of the mean intensity J, averaged over the absorption profile and the mean number of scatterings required for photon escape. This leads to major simplifications in the resultant equations for J. In particular, the integration over frequency is taken into account at each step, and it is no longer necessary to integrate the final equations over frequency. Also, use of the mean intensity eliminates the need to integrate over angle. Thus, the usual equations in three dimensions (optical depth, frequency, and direction angle) are replaced by a first-order differential equation in one dimension (mean number of scatterings). For certain idealized problems algebraic solutions are readily obtained. The method appears to offer major simplifications for problems dealing with multidimensional media. (auth)

56877 PECULIAR B STAR IN THE OLD DISK POPULATION: 38 DRACONIS. Adelman, Saul J.; Sargent, Wallace L. W. (California Inst. of Tech., Pasadena). Astrophys. J.; 176: No. 3, 671-6(15 Sep 1972).

Eggen has found that the sixth-magnitude late B-type star 38 Draconis has a space motion typical of the old disk population. A study of coudé spectrograms has shown that this star has a peculiar composition which is similar, but not identical, to the Population I manganese–mercury stars. (auth)

56878 EFFECTIVE TEMPERATURES OF MASSIVE STARS AS A FUNCTION OF CHEMICAL COMPOSITION AND MASS. Hartwick, F. D. A.; Vanden Berg, Don A. (Univ. of Victoria, B. C.). Astrophys. J.; 176: No. 3, 677-9(15 Sep 1972).

Theoretical models for main-sequence stars of 50 and 100 $M_\odot$ were constructed for a range in heavy-element abundance $10^{-4} < Z < 10^{-1}$. For a given mass, significant differences in the stellar effective temperature and size of H II region were found for moderate changes in Z. These differences were such that stars with lower Z have higher effective temperatures. The results suggest that the expected increase in excitation temperature in low-Z H II regions due to less efficient cooling will be enhanced. (auth)

56879 ADVANCED EVOLUTION OF MASSIVE STARS. I. HELIUM BURNING. Arnett, W. David (Univ. of Texas, Austin). Astrophys. J.; 176: No. 3, 681-98(15 Sep 1972).

This is the first in a series of papers which will describe a survey of the later stages of evolution of massive stars, beginning at helium burning and proceeding through the final hydrodynamic stages. In this paper, (1) the motivation and astrophysical background for the survey are developed and discussed, (2) the methods and approximations to be used are described, (3) the initial models for the survey are developed, (4) the techniques to be used are compared with other investigations of helium stars, (5) the "single-star" approximation is examined by explicit comparison with published evolutionary sequences of core helium burning, (6) the relation between helium core mass M_α and total mass M is calibrated, and (7) helium-burning nucleosynthesis is reexplored using a revised rate for $3\alpha \rightarrow {}^{12}C$ and various values for the rate of ${}^{12}C(\alpha,\gamma){}^{16}O$. The latter results are fitted by a simple function of M_α and of θ_α^2 for the 7.12-MeV level in ${}^{16}O$. (auth)

56880 ADVANCED EVOLUTION OF MASSIVE STARS. II. CARBON BURNING. Arnett, W. David (Univ. of Texas, Austin). Astrophys. J.; 176: No. 3, 699-710(15 Sep 1972).

This is the second in a series of papers dealing with the evolution of massive stars; the stage of hydrostatic carbon burning is discussed. A simple approximate technique for calculating energy generation and nucleosynthesis during carbon burning is presented. It is found that (1) convection outside shell sources may have a different character during neutrino-dominated evolution, (2) under the influence of neutrino emission, carbon burning produces small post-carbon-burning cores; (3) very massive stars ($M_\alpha \gtrsim 64\ M_\odot$ and $M \gtrsim 110\ M_\odot$ or so) encounter the electron-pair instability, and (4) neon burning will be more important for smaller-mass stars. Comparison is made with some other recent investigations of carbon burning in stars. (auth)

56881 STUDIES OF HEAVY-ELEMENT SYNTHESIS IN THE GALAXY. I. SEPARATION OF r- AND s-PROCESS ABUNDANCES. Butcher, H. R. (Australian National Univ., Canberra). Astrophys. J.; 176: No. 3, 711-22(15 Sep 1972).

A survey designed to search for variations in r- and s-process abundances in the Galaxy is described. The data are obtained with an échelle grating system and image-tube in the coudé of the Mount Stromlo 74-inch reflector. Initial results of the survey suggest that only very small, if any, relative abundance variations are to be found among dwarf stars of the galactic disk, but small relative excesses of the r-process element Eu have been discovered in two of the three metal-poor, intermediate-population stars so far examined. (auth)

56882 EQUATION OF STATE OF NEUTRON-STAR MATTER AT SUBNUCLEAR DENSITIES. Barkat, Zalman (California Inst. of Tech., Pasadena); Buchler, Jean-Robert; Ingber, Lester. Astrophys. J.; 176: No. 3, 723-38(15 Sep 1972).

An extended nuclear Thomas–Fermi model is used in conjunction with a Wigner–Seitz model to determine the ground-state composition of cold catalyzed matter for densities ranging from 10^8 to 10^{14} g cm^{-3}, allowing for inhomogeneities on a nuclear scale (nuclei or "clusters"). As a function of the average density, the proton number Z of the clusters first increases from $Z \approx 29$ at 1.4×10^8 g cm^{-3} to a maximum of $Z \approx 35$ at 3×10^{12} g cm^{-3}, and then decreases until the clusters gradually evanesce just above 10^{14} g cm^{-3}. This transition appears to be smooth—in contrast to the "neutron drip" phase transition which occurs at 3.7×10^{11} g cm^{-3}. A tabulation of the equation of state is presented. (auth)

56883 COOLING OF PULSARS. Tsuruta, Sachiko (Goddard Space Flight Center, Greenbelt, Md.); Canuto, V.; Lodenquai, J.; Ruderman, M. Astrophys. J.; 176: No. 3, 739-44(15 Sep 1972).

Cooling rates are calculated for superfluid neutron stars of about 1 $M_\odot$ and 10 km radius, with magnetic fields from zero to about 10^{14} gauss, when possible internal friction effects are neglected. Results show that most old pulsars are so cold that thermal ionization of surface atoms would be negligible. At an age of 10^6 years and with canonical magnetic fields of 10^{12} gauss, the estimated stellar surface temperature is several thousand to a hundred thousand degrees. However, if magnetic fields and superfluid states of nucleons are neglected, the same surfaces would be about $10^{6\circ}$K. (auth)

56884 INTERSTELLAR CIRCULAR POLARIZATION: DATA FOR SIX STARS AND THE WAVELENGTH DEPENDEENCE. Kemp, James C.; Wolstencroft, Ramon D. (Univ. of Hawaii, Honolulu). Astrophys. J.; 176: No. 3, L115-18(15 Sep 1972).

Circular polarization attributed to twisted grain alignment along the line of sight has now been detected in light from six early-type stars, including the cases o Sco and σ Sco A reported earlier. Detailed q(λ) data for the latter two change sign in the red as predicted by a simple model. (auth)

56885 NITROGEN B SUPERGIANT IN A PECULIAR ECLIPSING SYSTEM. Walborn, Nolan R. (Univ. of Toronto). Astrophys. J.; 176: No. 3, L119-21(15 Sep 1972).

The absorption-line spectrum of the interesting southern spectroscopic binary HD 163181 was found to be nitrogen-enhanced and extremely deficient in carbon and oxygen. Since there is evidence for mass loss or mass transfer in the system, the possibility exists that these spectroscopic anomalies are due to material processed through the CNO cycle in one of the massive components. (auth)

56886 EXTRAGALACTIC Ca II ABSORPTION LINES IN THE SPECTRA OF THE SUPERNOVA IN NGC 5253. Sistero, R. F.; Castore de Sistero, M. E. (Observatorio Astronomico, Cordoba, Argentina). Astrophys. J.; 176: No. 3, L123-6(15 Sep 1972).

Spectroscopic observations at 39 Å mm^{-1} of the supernova in NGC 5253 (1972) are reported. The spectrum shows characteristic emission bands of Type I supernovae. Interstellar galactic Ca II lines are observed; also a redshifted H and K absorption pair is present ($cz = +428 \pm 8$ km s^{-1}). It is probably formed in the interstellar gas of NGC 5253. (auth)

56887 CIRCUMSTELLAR GAS EMISSION AMONG PRE-MAIN-SEQUENCE STARS IN Ic ORIONIS AND NGC 2264. Smith, Myron A. (Univ. of California, Santa Cruz). Astrophys. J.; 176: No. 3, 617-22(15 Sep 1972).

Photometric and spectrophotometric observations of pre-main-sequence A-type stars in the Ic Orionis association are reported, confirming by analogy the suggestion of Strom et al. of Balmer emission in such stars. Actually, the small scatter in the (Δc_1, ΔM_v) diagram for these stars would suggest somewhat smaller amounts of visual extinction by circumstellar dust than inferred (and observed) in the case of NGC 2264. Based on a reexamination of gas and dust emission data for NGC 2264, it is concluded that no general correlation between circumstellar gas and dust can be demonstrated. It is argued that a spread in age rather than such a correspondence is most important in explaining the observed range of Strömgren Δc_1 in both stellar groups. (auth)

56888 INFRARED SURVEYS OF THE SOUTHERN MILKY WAY. II. SUSPECTED SUPERGIANT M STARS. Albers, Henry (Vassar College Observatory, Poughkeepsie, N. Y.). Astrophys. J.; 176: No. 3, 623-8(15 Sep 1972).

An infrared objective-prism survey was carried out along the southern Milky Way. Suspected M-type supergiants were selected from the presence of a CN absorption feature at $\lambda 7900$. A catalog of 170 M stars showing this feature is given. (auth)

56889 MODEL ATMOSPHERES FOR COOL SUPERGIANT STARS. Alexander, David R.; Johnson, Hollis R. (Indiana Univ., Bloomington). Astrophys. J.; 176: No. 3, 629-43(15 Sep 1972).

Model atmospheres for cool giant stars having a wide range of chemical composition were calculated over the ranges $2500^\circ \leq T_{eff} \leq 4000^\circ$K and log g = 1.0 to −1.0 based on LTE and a plane-parallel, horizontally homogeneous structure. Energy transport by both radiation and convection was included, although the latter was usually unimportant. Opacity sources included a smoothed contribution due to the bound−bound transitions of the molecules CN, CO, and H_2O as well as absorption and scattering due to H, H^-, H_2, and H_2^-. Either CN or H_2O was usually the dominant opacity in the outer atmosphere, depending on whether $C/O > 1$ or $C/O < 1$ while H^- usually dominated deep in the photosphere. Generally, as O was depleted in the atmosphere, the pressure was increased; if $C/O > 1$, however, the pressure was decreased, compared to a corresponding model with solar composition. Atomic line blanketing was also important. (auth)

56890 PECULIAR O6f STAR HD 148937 AND THE SYMMETRICALLY SURROUNDING NEBULAE. Johnson, Hugh M. (Lockheed Missiles and Space Co., Palo Alto, Calif.). Astrophys. J.; 176: No. 3, 645-9(15 Sep 1972).

Peculiarities of the system of nebular shells around HD 148937, of which NGC 6164-5 are the innermost, are discussed with reference to optical and radiofrequency data. A standard extrapolation from the optical flux density of NGC 6164-5 predicts a marginally detectable radio source, and it does not appear in the relevant surveys. The Of star and its two companions are photometered around 4640, 4686, and 4861 Å. The result confirms Westerlund's absolute visual magnitude of about −6 for the Of star and confirms his rejection of NGC 6164-5 as a planetary nebula. The ultraviolet continuum of the star is observed with the OAO-2/WEP photometers and, after standard reddening corrections are applied, the spectrum is compared with some models. (auth)

56891 RADIO OBSERVATIONS OF EARLY-TYPE STARS. Balick, Bruce (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. Lett.; 12: No. 1, 21-3(Sep 1972).

A survey of 32 O, B, and Wolf−Rayet stars with the NRAO interferometer failed to detect unresolved radio sources coincident with any of the stellar positions. The detection limits range from 10 to 50×10^{-29} W m^{-2} Hz^{-1}. Consequently, the physical processes that produce the radio radiation observed in other types of stars are not as important for early-type stars. Limits on physical conditions near the star are derived. The nature of the "superbright radio knots" observed by Miley et al. is briefly discussed. (auth)

56892 VARIABLE X-RAY SOURCE CEN X-3 AS A RADIALLY PULSATING WHITE DWARF. Vauclair, G. (Observatoire de Meudon, France). Astrophys. Lett.; 12: No. 1, 17-19(Sep 1972).

On the basis of a study of the vibrational stability of white dwarf models, it is argued that the pulsation period of the Cen X-3 variable x-ray source is the first harmonic of radial pulsation of a 0.6 $M_\odot$ white dwarf rather than the fundamental of a 1.1 $M_\odot$ white dwarf, as proposed in a recent model of this source. (auth)

56893 TRANSITION FROM SHALLOW TO DEEP CONVECTION ZONES IN STARS. Mullan, D. J. (Armagh Observatory, Ireland). Astrophys. Lett.; 12: No. 1, 13-16(Sep 1972).

It is generally believed that the existence of fast stellar rotation in main sequence stars with spectral types earlier than F4, and slow rotation in later types, can be explained by the onset of deep convection zones at spectral type F4. This letter points out that this belief is not valid when evolutionary effects are allowed for, and that the transition to deep convection zones must occur later than F4. Observations of hot chromospheres, rotational velocities in the Pleiades, and lithium depletion give tentative support to the hypothesis that the transition to deep convection zones occurs near G0. (auth)

56894 POSSIBLE PHOTOIONIZATION OF THE INTERGALACTIC MEDIUM BY HOT WHITE DWARFS. Hills, J. G. (Univ. of Michigan, Ann Arbor). Astrophys. Lett.; 12: No. 1, 9-11(Sep 1972).

At the present epoch hot white dwarfs in galaxies radiate enough ionizing radiation into intergalactic space to ionize an intergalactic medium with a density up to 5×10^{-29} gm cm^{-3}, or nearly five times greater than that required for closure of the universe. At times earlier than some critical epoch in the universe the intergalactic material was too dense for all of it to be ionized by radiation from galaxies. In this situation each cluster of galaxies has a Strömgren sphere around it, and the remaining cool, un-ionized gas is compacted by the pressure of the higher temperature H II gas into dense packets lying between the overlapping Strömgren spheres of adjacent clusters. These intergalactic clouds may be responsible for the multiple redshift, very narrow absorption lines seen in the spectra of some quasars having emission line redshifts in excess of $z = 2$. (auth)

56895 INFLUENCE OF METAL LINES ON THE COLORS OF CEPHEIDS IN THE SMALL MAGELLANIC CLOUD. Bell, R. A. (Univ. of Maryland, College Park); Parsons, Sidney B. Astrophys. Lett.; 12: No. 1, 5-8(Sep 1972).

Synthetic spectra are used to confirm that the blueness of Cepheids in the SMC relative to Cepheids in the Galaxy and the LMC is entirely explained by reduced line blocking, corresponding to a factor of four in metal deficiency. Strömgren photometry should provide a test of this composition difference. (auth)

56896 GRAVITATIONAL COLLAPSE OF HOMOGENEOUS SPHERES. Misra, R. M.; Srivastava, D. C. (Gorakhpur Univ., India). Nature (London) Phys. Sci.; 238: No. 86, 116(21 Aug 1972).

In the study of adiabatic contraction of perfect fluid spheres the problem of gravitational bounce or collapse to a singularity has been studied under the following assumptions: first, that the motion is isotropic; second, that the density is uniform. In addition, to make the models physically meaningful, the usual regularity conditions at the centre and the joining conditions at the interface between the region occupied by matter and the surrounding empty space are assumed to hold. It is shown that the assumption of isotropy is redundant in the sense that the conditions of uniform density and regularity at the centre necessarily lead to the first condition. (auth)

56897 FOUR-COLOUR AND Hβ PHOTOMETRY OF SOME BRIGHT SOUTHERN STARS. Stokes, N. R. (Australian National Univ., Canberra). Mon. Notic. Roy Astron. Soc.; 159: No. 2, 165-77(1972).

Observations of 370 bright southern A, F, and B stars in the four-color (y,b,v,u) and Hβ systems are reported. (auth)

56898 CLUSTER NGC$_{330}$ IN THE SMC. PAPER II. Hα EMISSION IN MAIN SEQUENCE STARS. Feast, M. W. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 159: No. 2, 111-18(1972).

An Hα survey of the cluster NGC$_{330}$ in the Small Magellanic Cloud was carried out. Eighteen stars which are main sequence objects, according to Arp's photometry, were observed and ten found to be Be stars. Three other stars without photometry are probably Be stars. All eight main sequence stars investigated with M_V in the range −3.6 to −4.2 are Be stars. This latter result is closely similar to Schild's result for the extreme nucleus of the λ Per cluster. The significance of these results is discussed. The position of the main sequence of NGC_{330} in the color-magnitude diagram probably requires significant correction for the effects of large stellar rotational velocities before a comparison can be made with a main sequence of nonrotating stars. (auth)

56899 LIGHT VARIATION AND ORBITAL ELEMENTS OF TZ LYRAE. Binnendijk, L. (Univ. of Pennsylvania, Philadelphia). Astron. J.; 77: No. 7, 595-602(Sep 1972).

A total of 581 observations in yellow light and a total of 581 observations in blue light of TZ Lyrae are presented. The observations were freed from the light of the fainter component of the visual double-star system of which the variable is the brighter component. A consistent set of orbital elements is presented which shows that secondary minimum is caused by a total eclipse. Both components of the variable seem to be very close to the main sequence. The fainter component of the visual double appears to be somewhat below the main sequence if this system is a physical one. (auth)

56900 SPECTROSCOPIC-BINARY FREQUENCY AMONG EXTREME HIGH-VELOCITY DWARFS. Crampton, D. (Dominion Astrophysical Observatory, Victoria, B. C.); Hartwick, F. D. A. Astron. J.; 77: No. 7, 590-4(Sep 1972).

The conclusion of Abt and Levy that short period spectroscopic binaries occur relatively less frequently among Population II stars is confirmed by considering an enlarged sample of extremely metal-deficient subdwarfs. (auth)

56901 LIGHT VARIATION OF AU SERPENTIS. Binnendijk, L. (Univ. of Pennsylvania, Philadelphia). Astron. J.; 77: No. 7, 603-9(Sep 1972).

A total of 833 observations in yellow light and a total of 828 observations in blue light of AU Ser are presented. The light curve changes its shape in a rather short time interval. Maximum light occurs at phase angles 100° and 260°. The components are too distorted to give reliable orbital elements according to the Russell model. (auth)

56902 ECLIPSING BINARY HR 6611. Zissell, R. (Leander McCormick Observatory, Charlottesville, Virginia). Astron. J.; 77: No. 7, 610(Sep 1972).

One thousand photoelectric V observations were made of the eclipsing binary HR 6611. The period was found to be 3.894 977 days. The amplitude of primary eclipse was 0.18 mag and that of secondary 0.17 mag. The spectroscopic orbit was recomputed and the results combined with those from the newly determined eclipsing orbit to give masses and radii of the components. The spectra of the stars are most likely Am and the masses and radii agree well with main-sequence values. (auth)

56903 UNUSUAL NEBULA ASSOCIATED WITH HD 87634. Van Den Bergh, Sidney (Univ. of Toronto). Publ. Astron. Soc. Pac.; 84: No. 500, 594-5(Aug 1972).

The star HD 87634, which exhibits a nova-like spectrum, is found to be embedded in a nebula of unusual structure. (auth)

56904 ROTATIONAL VELOCITIES AND SPECTRAL TYPES OF SOME A-TYPE STARS. Levato, O. H. (Observatorio Astronomico, La Plata, Argentina). Publ. Astron. Soc. Pac.; 84: No. 500, 584-8(Aug 1972).

The rotational velocities and MK spectral types of more than 100 southern A-type stars are described. (auth)

56905 EMISSION-LINE STARS IN THE ζ SCULPTORIS CLUSTER. Bond, Howard E. (Louisiana State Univ. Observatory, Baton Rouge). Publ. Astron. Soc. Pac.; 84: No. 500, 583 (Aug 1972).

New objective-prism plates fail to confirm the reported presence of $H\alpha$-emission stars in the region of the ζ Scl cluster. (auth)

56906 MULTICOLOR PHOTOMETRY OF THE M DWARF PROXIMA CENTAURI. Frogel, J. A. (Harvard Coll. Observatory, Cambridge, Mass.); Kleinmann, D. E.; Kunkel, William; Ney, E. P.; Stecker, D. W. Publ. Astron. Soc. Pac.; 84: No. 500, 581-2(Aug 1972).

Photometric observations of Proxima Centauri between 0.3μ and 5μ show that this star has an effective temperature of 2700°K, a bolometric luminosity of 6.7×10^{30} ergs sec^{-1}, and a radius of 1.3×10^{10} cm, agreeing with the calibration of the faint end of the main sequence made by Greenstein, Neugebauer, and Becklin (1970). (auth)

56907 PHOTOELECTRIC LIGHT CURVES OF AK HERCULIS. Bookmyer, Beverly B. (Univ. of Arizona, Tucson). Publ. Astron. Soc. Pac.; 84: No. 500, 566-80(Aug 1972).

AK Herculis is a W Ursae Majoris-type eclipsing binary system which undergoes complete eclipses; secondary eclipse is total. Approximately 2000 photoelectric observations of this system were obtained with B and V filters within a two-week interval in 1966. Three successive light curves formed from the observations at each effective wavelength are in good agreement and show no evidence of cycle-to-cycle variation. Secondary minimum is slightly displaced from phase 0.5 and there is a difference in the heights of the maxima, features which also appear in light curves of this system observed by other investigators. A single, well-defined curve was formed from all the observations at each effective wavelength, and these curves differ slightly over a small portion of the light cycle with those observed by Binnendijk in 1960. A study of all the available data suggests that while the difference in the heights of the maxima varies, the depths of the minima with respect to the maximum following primary minimum remain essentially constant. Three analyses of the observations for the system's orbital elements are presented and discussed. (auth)

56908 LIGHT VARIATIONS OF THREE SPECTROSCOPIC BINARIES. Rao, N. Kameswara (Univ. of California, Santa Cruz). Publ. Astron. Soc. Pac.; 84: No. 500, 563-5(Aug 1972).

Three spectroscopic binaries HD 208095, 14 Cep, and HD 217312 were observed to see if they show any of the periodic light variations of a few hours in length that are characteristic of β Cephei stars. HD 208095 and 14 Cep did not show any such variations with amplitude greater than 0.01m, but 14 Cep and HD 217312 seemed to show variations of eclipsing binary type. (auth)

56909 UBV PHOTOMETRY OF THE RING IN SW CYGNI. Hall, Douglas S.; Garrison, Loring M. Jr. (Vanderbilt Univ., Nashville). Publ. Astron. Soc. Pac.; 84: No. 500, 552-62(Aug 1972).

New UBV photometry of SW Cyg obtained in 1967, 1968, and 1969 is presented. Recent times of minimum yield a new ephemeris which suggests the period has not varied appreciably between 1964 and 1969. The bottom of primary eclipse exhibits several complications: asymmetries, nonconstant light between second and third contact, and an apparent ultraviolet excess in the cool subgiant of $\delta(U-B) = 0.3m$. The most satisfactory explanation for this excess in SW Cyg (and presumably in most Algol-like binaries) is contamination by light from an envelope surrounding the hot star that is not completely eclipsed at midprimary minimum. From the shape of the 1968 primary eclipse a map of the distribution of light from this envelope is constructed. The light on one side, by far the strongest in U, is a consequence of the gas stream which must be striking the hot star on its trailing side. The light on the other side, however, has the color of the hot star and it is suggested that this must originate from a protuberance in the photosphere of the hot star. It is shown that the many photometric complications observed recently by Walter in his complete BV light curve of SW Cyg can be explained by our envelope-protuberance model. (auth)

56910 ECLIPSING BINARY WW CYGNI: AN UNLIKELY CANDIDATE FOR PRE-MAIN-SEQUENCE CONTRACTION. Hall, Douglas S.; Wawrukiewicz, Anthony S. (Vanderbilt Univ., Nashville). Publ. Astron. Soc. Pac.; 84: No. 500, 541-51(Aug 1972).

A new UBV photoelectric light curve is presented and solved. An excellent fit is achieved only with the assumption of $x_s = 0.0$. Approximate allowance is made for the perturbation which results because the two components have dissimilar shapes. The color indices indicate spectral types of B7(V) and G8(IV), a reddening of $E(B-V) = 0.16m$, and an apparent ultraviolet excess of $\delta(U-B) = 0.10m$ in the cool subgiant. The period variation is definitely not sinusoidal; it is more probably a result of abrupt period changes around 1903, 1906, 1911, 1930, 1943, 1961, and 1963. The absolute dimensions are discussed. Assumption that the subgiant exactly fills its lobe leads to a rather large, but not unreasonably large, mass for the B7 star. The evolutionary status is discussed and the conclusion reached that WW Cyg is probably not in premain-sequence contraction. (auth)

56911 SPECTROSCOPIC STUDY OF AS CAMELOPARDALIS. Hilditch, R. W. (Dominion Astrophysical Observatory, Ottawa). Publ. Astron. Soc. Pac.; 84: No. 500, 519-22(Aug 1972).

Spectrographic observations of this eclipsing binary system are presented for the first time. It is shown that both components are main-sequence stars which conform to the theoretical calculations of Iben (1967). (auth)

56912 PHOTOMETRY OF SYMBIOTIC AND VV CEPHEI STARS IN THE NEAR INFRARED (WITH A NOTE ON MWC 56). Swings, J. P.; Allen, D. A. (Carnegie Inst. of Washington, D. C.). Publ. Astron. Soc. Pac.; 84: No. 500, 523-7(Aug 1972).

The majority of symbiotic and VV Cephei stars have near infrared continua closely resembling those of late-type stars. Evidence for weak infrared excesses has been found in the three stars RY Sct, W Cep, and U Lac. RX Pup and V1016 Cyg exhibit very prominent infrared excesses which are attributable to thermal radiation from circumstellar dust. The "Bep" star MWC 56, whose spectrum shows Fe II and [Fe II] emission lines in the blue, possesses the absorption lines of a G or K component in the red. No substantial infrared excess is present. (auth)

56913 MISCELLANEOUS UBV OBSERVATIONS OF SYMBIOTIC STARS. Fernie, J. D. (Univ. of Toronto). Publ. Astron. Soc. Pac.; 84: No. 500, 528(Aug 1972).

Occasional photometric observations of nine symbiotic stars during the years 1967–69 are reported. (auth)

56914 HD 90386: A NEW SHORT-PERIOD VARIABLE STAR. Jerzykiewicz, Mikolaj (Lowell Observatory, Mass.). Publ. Astron. Soc. Pac.; 84: No. 500, 529-30(Aug 1972).

HD 90386 has been found to vary in yellow light with the period of about 0.0799d. The light range is close to 0.01m and appears to be slightly variable. The star is probably a member of the δ Scuti group of variable stars. The constancy of light of 23 Sex has been confirmed. (auth)

56915 STRUCTURE OF CHEMICALLY HOMOGENEOUS MAIN-SEQUENCE STARS. Motz, Lloyd (Columbia Univ., New York). Publ. Astron. Soc. Pac.; 84: No. 500, 465-88(Aug 1972).

The general differential equations for the structure of stars are developed. These are then applied to the analysis of the structure of chemically homogeneous main-sequence stars. Some general deductions are made about the dependence of the slope of the main sequence on the energy generating cycle. The variation in the position of the main sequence with chemical composition is also discussed. (auth)

56916 METAL DEFICIENCY OF TWO MEMBERS OF M67. Bessell, M. S. (Mount Stromlo and Siding Spring Observatories, Canberra, Australia). Publ. Astron. Soc. Pac.; 84: No. 500, 489-91(Aug 1972).

Hydrogen line profiles and K-line strengths for F131 and F90 probable members of M67 indicate a metal deficiency of a factor of 1.7 relative to the Sun and a reddening for these two stars of about $E(b-y) = 0.05$. (auth)

56917 SEARCH FOR DIFFUSE INTERSTELLAR FEATURES IN STARS WITH CIRCUMSTELLAR DUST SHELLS. Snow, Theodore P. Jr.; Wallerstein, George (Univ. of Washington, Seattle). Publ. Astron. Soc. Pac.; 84: No. 500, 492-6(Aug 1972).

A search was made for diffuse features at $\lambda\lambda$4430, 5780, 5796, and 6613 in the spectra of 17 stars which show infrared excesses or other grounds for believing that they have dusty envelopes. In no case could diffuse bands be identified that may be ascribed to the circumstellar envelope. It was concluded that the grains in circumstellar envelopes are not identical with the grains in the general interstellar medium. (auth)

56918 ANALYSIS OF THE SMALL MAGELLANIC CLOUD SUPERGIANT HD 7583. Przybylski, A. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc.; 159: No. 2, 155-63(1972).

In a coarse analysis the Small Magellanic Cloud star HD$_{7583}$ was compared with α Cygni and HD$_{67456}$. It was found that helium is normal or nearly normal in HD$_{7583}$ and metals are deficient by a factor of 10. (auth)

56919 SPECTRAL CLASSIFICATION OF CLOSE STAR GROUPS WITH AN OBJECTIVE-PRISM CAMERA OF VERY LOW DISPERSION. Stoyanova, K. T. (Central Astronomical Observatory, Pulkovo, USSR). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 165-7(1972).

Translated from Astron. Zh.; 49: No. 1, 210-12(1972).

A method of spectral classification at very low dispersion ($\approx$10,000 Å/mm) is described for close groups of faint stars. Basic criteria are developed for a rough classification of stars by the shape of their spectrum on the plate. (auth)

56920 HARTWICK'S TWO-DIMENSIONAL CLASSIFICATION OF GLOBULAR CLUSTERS. Mironov, A. V. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 105-6(1972).

Translated from Astron. Zh.; 49: No. 1, 134-6(1972).

The helium abundance index Y introduced by Hartwick, despite his claim, will not serve as a second parameter defining the shape of the horizontal branch in the H–R diagram of globular clusters. (auth)

56921 GLOBULAR CLUSTERS AND THE DISTANCE SCALE. Kukarkin, B. V.; Rusev, R. M. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 95-104(1972).

Translated from Astron. Zh.; 49: No. 1, 121-33(1972).

Mean apparent V and B magnitudes of the five (V5, B5) and 25 (V25, B25) brightest stars in 37 globular clusters were derived from color–magnitude diagrams. Special attention was given to the completeness of the star samples. Previous determinations of the mean apparent magnitudes of bright globular-cluster stars contain large errors. Apparent V and B distance moduli were derived for 20 globular clusters from their RR Lyrae stars, and for 18 clusters from the horizontal-branch stars. The absolute magnitudes of these stars in each cluster were determined from Christy's transition period P_{tr} and from empirical equations relating the absolute magnitudes of the RR Lyrae stars to the metallicity index IM and the integrated cluster spectrum. The absolute magnitudes adopted for the RR Lyrae stars were tabulated for 31 clusters. The apparent V and B distance moduli were regarded as functions not merely of the bright-star magnitudes V5, B5, V25, B25, but also of the integrated absolute magnitude of the cluster itself and its metallicity index. Expressions were derived for the apparent distance moduli in terms of the bright-star magnitudes. These apparent moduli were consistent with one another and agreed with those determined from RR Lyrae stars to within ±0.2. New apparent distance moduli were tabulated for 43 globular clusters; they will be used to calibrate moduli obtained by other methods. The distances were found to be systematically smaller than previously accepted; thus a revision of the cosmic distance scale might be necessary. (auth)

56922 APPROXIMATE SOLUTION TO THE EQUATION OF RADIATIVE TRANSFER IN LINE FREQUENCIES. Ivanov, V. V. (Leningrad State Univ.). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 91-4(1972).

Translated from Astron. Zh.; 49: No. 1, 115-20(1972).

A simple approximation is given for the resolvent function of the integral equation of transfer for the line radiation in a plane layer. The approximate value of the source function appears to deviate from the exact value by no more than a factor of 2 for any optical thickness τ_0 of the layer ($0 < \tau_0 \leq \infty$), any particle albedo λ ($0 < \lambda \leq 1$), any plausible line absorption coefficient, and an arbitrary source distribution. The approximation rests on certain asymptotic properties of the solutions to the equation of transfer. (auth)

56923 POLARIZATION MEASUREMENTS OF THE SUPERNOVA IN M101. Shakhovskoi, N. M.; Efimov, Yu. S. (Crimean Astrophysical Observatory, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 7-9(1972).

Translated from Astron. Zh.; 49: No. 1, 11-14(1972).

The results are reported of multicolor polarimetry of a Type II supernova in the galaxy M101, as carried out with the 2.6-m Shain reflector in August–September 1970. The observations reveal an intrinsic polarization of the supernova radiation, increasing toward shorter wavelengths. (auth)

56924 PHYSICAL CHARACTERISTICS OF TYPE I SUPERNOVA ENVELOPES DURING THE INITIAL EXPANSION PHASE. II. DEVELOPMENT OF TYPE I SUPERNOVA SPECTRA AFTER MAXIMUM LIGHT. Mustel, E. R. (Astronomical Council, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 10-22(1972).

Translated from Astron. Zh.; 49: No. 1, 15-30(1972).

The presence of a velocity gradient and a temperature gradient in Type I supernova envelopes is discussed, as well as their combined influence on the stellar spectrum. The development of the supernova spectra is analyzed according to Fe II absorption lines having a metastable lower level. These lines play a predominant role in Type I supernova spectra from $\lambda \approx 4000$ Å to $\lambda \approx 5300$ Å. The lines of Na I, Ca II, Sc II, Si II, and S II are discussed. Arguments are given to explain why these particular lines should play a major role in such spectra. The "anomalies" observed in the spectrum of the 1967 supernova in NGC 3389 are interpreted. The general conclusion is reached that envelopes of different supernovae can expand at different velocities. (W.D.M.)

56925 SURVEY OF STELLAR OUTBURSTS OF THE PRETELESCOPIC ERA. Pskovskii, Yu. P. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.) 16: No. 1, 23-31(1972).

Translated from Astron. Zh.; 49: No. 1, 31-41(1972).

A list is presented of 125 objects qualifying as stars that have suffered outbursts. Possible supernovae and recurrent novae are discussed, including V603 Aql, GK Per, the novae of 393 and 1600, the slow novae of 396 and of 1431, and the nova of 1006, at whose site a bright stellar remnant of 9 to 10 $M_\odot$(IR Nor ?) should be located. (auth)

56926 FORMATION OF CORONAL LINES IN THE SPECTRA OF NOVAE. I. Gorbatskii, V. G. (Leningrad State Univ.). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 32-40(1972).

Translated from Astron. Zh.; 49: No. 1, 42-53(1972).

The conditions governing the formation of coronal lines in nova spectra are investigated. Prior to their outburst, some novae and recurrent novae are surrounded by extended gaseous envelopes arising from mass loss by the system. The principal envelope of the star, the envelope detached in an outburst, generates a strong shock wave that is propagated through the circumstellar envelope. The gas heated by the shock emits radiation in the coronal lines. The shock motion is calculated, and the time dependence of the ion and electron temperatures behind the shock front is established. Although initially $T_i \gtrsim 10^7$ °K, the values $T_e \gtrsim 10^6$ °K required to excite the coronal lines are not attained until 20 to 30 days after the outburst. A substantial rise in T_e before that time is prevented by the low ionization in the circumstellar envelope, and accordingly by the heavy energy losses of the electron gas to atomic excitation and ionization. (auth)

56927 NON-RADIAL PULSATIONS IN WHITE DWARF STARS. Warner, B.; Robinson, E. L. (Univ. of Texas, Austin). Nature (London) Phys. Sci.; 239: No. 88, 2-7(4 Sep 1972).

Five more oscillating white dwarf stars have been discovered. The data now available from these and other sources support an explanation of observed oscillations in dwarf novae in terms of g-mode pulsations. (auth)

56928 EVOLUTION OF THE NOVA CEPHEI 1971 SPECTRUM. Fehrenbach, Charles; Andrillat, Yvette (Observatoire de Haute Provence, Saint-Michel, France). Compt. Rend., Ser. B; 274: No. 21, 1179-84(24 May 1972). (In French).

The results of observations made since August 2, 1971 are presented. The observed emission from the Nova decreased rapidly during the measurement period. Only observations with average or low dispersion (66A/mm in the blue, 230A/mm in the near infrared) were made. Data for the 5,700 to 8,750A region are presented in a table. In the blue region, only one spectrum was recorded, December 15, 1971: the magnitude of the Nova was 12.8. (France)

56929 OPTICAL POLARIZATION ON THE SUPERNOVA IN NGC 5253. Wolstencroft, R. D.; Kemp, J. C. (Univ. of Hawaii, Honolulu). Nature (London); 238: No. 5365, 452(25 Aug 1972).

It is stated that if a Type I supernova is the result of the explosion of a star with a degenerate nucleus it is likely that a large magnetic field will be present in the radiating region for a short period following the outburst, and depending on the emission process a sufficiently large field could produce a measurable optical circular polarization. Measurements were made of the polarization of the bright supernova in the irregular galaxy NGC 5253. An explanation for the small upper limit on the circular polarization may be sought in terms of either (1) bremsstrahlung or synchrotron radiation, followed by radiative transfer and fluorescence, or (2) interstellar circular polarization, but it is unlikely that the latter is involved, and if either bremsstrahlung or synchrotron processes produced the emission close to the star, then the field was less than 10^5 G at the time of the observations. (UK)

56930 EFFECT OF RADIATION ON CONVECTION IN A POLYTROPIC ATMOSPHERE. Petrukhin, N. S. (Gorky Polytechnic Inst., USSR). Astrophysics (Engl. Transl.); 5: No. 4, 318-21(1969).

Translated from Astrofizika; 5: No. 4, 615-22(1969).

The method of perturbations was used to investigate analytically the effect of radiation on the convective instability of a polytropic atmosphere. Optically thick perturbations ($\tau \geq 1$) were considered. Matrix elements which can be used to determine the growth rate of the perturbations and the functions characterizing convective motion were determined in the first approximation for any mode. The expression for the growth rate of the main mode was derived in an explicit form and was investigated. (auth)

56931 FORMATION OF BINARY SYSTEMS DURING TRIPLE ENCOUNTERS. Agekyan, T. A.; Anosova, Zh. P.; Bezgubova, V. N. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 5: No. 4, 329-31(1969).

Translated from Astrofizika; 5: No. 4, 637-43(1969).

The probability of formation of binary systems as a result of random encounters of three gravitating bodies is discussed. Numerical solution of the equations of motion was carried out on a computer. In a random sample of 1600 triple encounters it was found that 656 of these ended in the formation of binary systems. The probability of formation of a binary star depends on the ratio H of the total energy of the system to the absolute value of the potential energy at the time of maximum triple interaction. Moreover, the maximum probability of formation of binary systems corresponds to the case in which the distances between the bodies at the time of maximum triple interaction are comparable. (auth)

56932 POLYTROPIC MODELS IN THE RELATIVISTIC GENERALIZED THEORY OF GRAVITATION. Mnatsakanyan, M. A. (Byurakan Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 5: No. 4, 332-4(1969).

Translated from Astrofizika; 5: No. 4, 645-9(1969).

Polytropic models were considered by Mnatsakanyan and Avakyan (1968) in the nonrelativistic approximation to the generalized theory. Some results are presented which were obtained for polytropic models with the equation of state $P = A\rho^{1+1/n}$ ($n \neq \infty$) in the relativistic generalized theory of gravitation. (W.D.M.)

56933 LINE FORMATION IN THE PRESENCE OF A MAGNETIC FIELD. PART I. THE SCATTERING MATRIX. Domke, H. (Astrophysical Observatory, Potsdam, Ger.). Astrophysics (Engl. Transl.); 5: No. 4, 259-63(1969).

Translated from Astrofizika, 5: No. 4, 525-37(1969).

A method of deriving the scattering matrix for resonance lines and any type of level splitting in a magnetic field is proposed. The matrix is given in the form of a sum of dyadic products. The right- and left-hand factors of the dyads depend only on the parameters characterizing the incident and scattered radiation, respectively. A relation is established between the scattering and absorption matrices. A dyadic expansion of the Rayleigh scattering matrix averaged with respect to the aximuth is obtained for the limiting case $H \rightarrow 0$. (auth)

56934 ERUPTIVE BINARIES. PART II. Smak, Josef (Astronomical Inst., Warsaw). Postepy Astron.; 20: No. 3, 205-18(1972). (In Polish).

A review is presented of problems connected with the physical properties of the components and the circumstellar matter and with the mechanisms of outbursts. (auth)

56935 HYDROGEN RECOMBINATION RADIO LINES. Kubiak, Marcin (Univ. of Warsaw). Postepy Astron.; 20: No. 3, 219-40(1972). (In Polish).

A review is given of the recent interpretations of radio line data for hydrogen in terms of the non-LTE theory. A brief account of some results is also given. (auth)

56936 EFFECT OF THE TIME SHIFT OF THE MIN II IN ECLIPSING BINARIES. Dworak, T. Z. (Jagellonian Univ., Krakow). Postepy Astron.; 20: No. 3, 251-6(1972). (In Polish).

It is concluded that the moment min II of eclipsing binaries should be systematically shifted relatively to the moment min I + P/2 owing to the difference in the distance to the observer of the occulting component in the min I and min II. An expression gives the amount of the expected shift in terms of the parameters of the system. A discussion of the parameter $\Delta t/P$ leads to the conclusion that, with the present methods of observation, the shift in phase of the min II should be appreciable for some stars at least. (auth)

56937 MIXING BETWEEN STELLAR ENVELOPE AND CORE IN ADVANCED PHASES OF EVOLUTION. IV. EFFECT OF SUPER-ADIABATICITY IN CONVECTIVE ENVELOPE. Nomoto, Ken-ichi; Sugimoto, Daiichiro (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 1, 46-65(Jul 1972).

Model envelopes of red supergiants are integrated taking into account the effect of superadiabatic temperature gradient by means of a standard mixing length theory. When the stellar luminosity is close to its upper limit (critical luminosity), the matter density in the envelope is so low that the heat exchange between the rising and descending convective elements is appreciable. Moreover, the radiation pressure is dominant as compared with the gas pressure. These result in a strong entropy gradient in the convective envelope. Such a strong entropy gradient tends to reduce or inhibit mixing of material by the penetration of the convective envelope into the core. However, quantitative results are quite sensitive to the ratio of the mixing length to the pressure scale-height. Assuming different values of the mixing length, the validity of the numerical results concerning the mixing, which were obtained in the earlier papers of this series, is discussed. Effect of active hydrogen-burning shell on the progress of mixing is also discussed in relation to the formation of a star having helium envelope. (auth)

56938 GRAVITATIONAL COLLAPSE OF A ROTATING STAR. I. FORMULATION. Tomita, Kenji (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 1, 78-103(Jul 1972).

First, a system of general relativistic hydrodynamical and gravitational field equations is generally formulated under Bondi-Sachs's coordinate condition, and then it is applied to an approximate description of dynamical motions of a slowly rotating axisymmetric star. The approximation comes from putting attention on the quantities of the first and second orders of magnitude with respect to small angular velocity. Moreover, the deviation of event horizon appearing in the strong field from the Schwarzschild surface and the behavior of the asymptotically flat field are examined, and, in order to see the dragging of local inertial frame by the strong field of that star, equations of motion for that frame are also considered. (auth)

56939 MAIN SEQUENCES OF SYNTHETIC CLUSTERS WITH FINITE FORMATION TIMES. Schlesinger, Barry M. (Indiana Univ., Bloomington). Astron. J.; 77: No. 7, 584-9 (Sep 1972).

Color-magnitude diagrams have been synthesized for clusters whose stars formed in a period of 15 million years. The average cluster ages range from 12 to 600 million years. In addition, H$-$R diagrams have been synthesized for the two youngest of these clusters. The maximum scatter in B$-$V at the magnitude of the top of the main sequence appears in the youngest cluster: 0.05 mag. In all clusters, the scatter decreases below the top to less than 0.01 mag at a point three magnitudes down from the top of the main sequence, a property which should distinguish the scatter due to finite formation time from scatter with other causes. The corresponding scatter in the H$-$R diagrams is two spectral subclasses. Gaps in the upper main sequence of the clusters younger than 10^8 years do not represent the hydrogen exhaustion and gravitational contraction phase of stellar evolution. Finite formation time complicates the use of star counts in different regions of the C$-$M diagram for studies of stellar evolution only if the cluster under study is sparse. Future efforts to study scatter in young clusters should use a photometric system, calibrated in terms of effective temperature, which is sensitive to effective temperature in hot stars. (auth)

56940 SEARCH FOR PULSES OF FLUORESCENCE PRODUCED BY SUPERNOVAE IN THE UPPER ATMOSPHERE. Charman, W. N.; Jelley, J. V. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., A (London); 5: No. 5, 773-80(May 1972).

Colgate suggested (Can. J. Phys. 46: S476-81 (1968)) that an exploding supernova should release an intense burst lasting a few microseconds of x and gamma ray photons. When it impinges on the upper atmosphere this burst produces a corresponding pulse of optical emission by fluorescence. A search was made for such light pulses, using a system of coincident light receivers. Although many pulses having the appropriate temporal characteristics were observed, their other properties appear to rule out their having an origin in supernova explosions. The character and possible origin of these events are discussed and their intrinsic interest is pointed out. (auth)(UK)

56941 β OBSERVED ENERGY DISTRIBUTION OF α LYRA AND β CEN AT 2000 TO 3800 Å. Gurzadyan, G. A.; Ohanesyan, J. B. Nature (London); 239: No. 5367, 90(8 Sep 1972).

It is stated that the space astrophysical observatory Orion, installed in the orbital station Salyut, has provided several slitless spectrograms of α Lyra and β Cen over the wavelength range 2000 to 3800 Å. These spectrograms were obtained in June 1971. The observed energy distribution in the spectrum of α Lyra was in good accord with theoretical models, and α Lyra can be used as a convenient and reliable spectrophotometric standard for wavelengths shorter than 3000 Å and at least down to 2000 Å. For β Cen the observations confirmed the occurrence of a jump in the continuous spectrum on the limit of the Balmer continuum, but over the wavelengths 3700 to 2400 Å there was good accordance between observed and computed energy distributions; below 2400 Å observations showed greater energy than theory. (UK)

56942 NOVAE. Glebocki, R. (Univ., Torun, Poland). Urania (Krakow); 41: 98-103(1970). (In Polish).

A general survey of various types of eruptive and explosive stars is given. Characteristic features of a nova star are presented: light curve and ejection of matter during explosion. Reasons and physical mechanisms for the explosion are presented. (auth) (NSA of Poland)

56943 INTERSTELLAR LINES IN THE SPECTRUM OF THE SUPERNOVA IN NGC 5253. Wallerstein, George (Univ. of Washington, Seattle); Conti, Peter S.; Greenstein, Jesse L. Astrophys. Lett.; 12: No. 2, 101-2(Oct 1972).

Radial velocities and equivalent widths are presented for interstellar Ca II and Na I lines in the spectrum of the supernova in NGC 5253. Components at -5 km/sec, presumably from our Galaxy, and +418 km sec presumably from gas in NGC 5253 are present. The ratio of Ca II/Na I in both clouds is more similar to high-velocity clouds in our Galaxy than to low-velocity gas. (auth)

56944 OH INFRARED STARS. Litvak, M. M.; Dickinson, Dale F. (Smithsonian Astrophysical Ovservatory, Cambridge, Mass.). Astrophys. Lett.; 12: No. 2, 113-17(Oct 1972).

The strong 1612-MHz maser emission from infrared stars is calculated to be the result of excitation mainly by near-infrared radiation and partly by collisions. Required conditions are 10^{17} to 10^{18} OH cm^{-2} and 10^6 and 10^7 H cm^{-3}, and the ratio N_{OH}/N_H is 10^{-5} to 10^{-4}. The circumstellar cloud contains $\gtrsim 10^{-4}$ $M_\odot$, and the star loses $\sim 10^{-6}$ $M_\odot$ yr^{-1}. Doppler overlap of far-infrared components with hyperfine splitting less than 18 MHz, combined with near-infrared pumping, results in main line emission, especially at 1667 MHz. Under very strong near-infrared pumping, far-infrared masers may occur at 61, 101, and 118 cm^{-1}. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 56892, 57019, 57023, 57030, 57140, 57291, 57448, and 57462.

56945 OBSERVATION OF SEVERAL X-RAY SOURCES IN 1970 SEPTEMBER. Price, R. E.; Seward, F. D.; Swift, C. D. (Univ. of California, Livermore). Astrophys. J.; 176: No. 3, 611-16(15 Sep 1972).

Several x-ray sources were detected in a survey of the sky on September 24, 1970. Intensities were measured for Tau XR-1, Cyg XR-1, Cyg XR-2, NGC 1275, Cas A, Cyg XR-3, 2U 0613 + 9, 2U 1908 + 0, and 2U 1912 $-$ 5. Locations are reported for the latter four sources, which are thus far unidentified with optical or radio objects. (auth)

56946 DETECTION OF FAR-INFRARED ASTRONOMICAL SOURCES. Furniss, I.; Jennings, R. E.; Moorwood, A. F. M. (University Coll., London). Astrophys. J.; 176: No. 3, L105-8(15 Sep 1972).

Four sources not previously observed in the far-infrared were detected in the range 40 to 350 μ from balloon altitude. Flux measurements were also obtained for the infrared objects in the Orion Nebula and NGC 2024. (auth)

56947 PHOTOMETRY OF MARKARIAN 205. O'Connell, Robert W. (Univ. of Virginia, Charlottesville); Saslaw, William C. Astrophys. J.; 176: No. 3, L109-11(15 Sep 1972).

Strömgren photometry of Markarian 205 shows no evidence for variability larger than 0.05 mag over periods on the order of minutes, hours, and days. The spectral energy distribution of Markarian 205 resembles those of quasi-stellar objects or compact galaxies with broad emission lines. (auth)

56948 SCORPIUS X-1: SEARCH FOR OPTICAL CIRCULAR POLARIZATION. Illing, R. M. E. (Columbia Univ., New York); Martin, P. G. Astrophys. J.; 176: No. 3, L113-14(15 Sep 1972).

Upper limits of 0.1% for the circular polarization of Sco X-1 were obtained in several wavelength bands covering the range 3700 to 8800 Å. (auth)

56949 STUDIES OF THE 21-cm LINE NEAR DARK DUST CLOUDS. Mahoney, M. J. (Univ. of British Columbia, Vancouver). Astrophys. Lett.; 12: No. 1, 43-8(Sep 1972).

This Letter reports observations of the 21-cm line on and near twelve dark dust clouds. Four of these objects show significant deficits in their hydrogen emission compared with nearby surrounding regions of the sky; one shows a marginal excess, and the remaining seven show no significant excesses or deficits. The results of these measurements have been compared with other work and the problem of whether the hydrogen in the clouds is atomic or molecular has been considered. (auth)

56950 SPECTROPHOTOMETRIC INVESTIGATIONS OF FILAMENTARY NEBULAE. Esipov, V. F.; Kaplan, S. A.; Lozinskaya, T. A.; Podstrigach, T. S. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 81-6 (1972).

Translated from Astron. Zh.; 49: No. 1, 105-9(1972).

Spectrograms of individual filaments in the supernova remnants S147 and VRO 42.05.01 were obtained with a contact image converter at the Cassegrain focus of the 125-cm reflector. The intensity ratios of the [N II] and [S II] lines to Hα and of [O III] to Hβ were determined. The emission spectrum of a shock wave traveling through a partially ionized gas was calculated as a function of velocity. The computed ratios of forbidden-line to hydrogen-line intensity agreed with spectrophotometry and interferometry of the filamentary supernova remnants NGC 6960, IC 443, and S22, as well as S147 and VRO 42.05.01. (auth)

56951 RADIO EMISSION FROM W49 AND THE ORION NEBULA IN THE WATER-VAPOR LINE. Akvilonova, A. B.; Ariskin, V. I.; Kutuza, B. G.; Sorochenko, R. L. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 79-80(1972).

Translated from Astron. Zh.; 49: No. 1, 102-4(1972).

Profiles of the water-vapor radio line at 1.35-cm wavelength in W49 and the Orion Nebula have been measured with the 22-m radio telescope. The integrated flux density and luminosity of the line radiation are computed. For W49, the radiation is variable with time at radial velocities from +40 to −90 km/sec. (auth)

56952 RESULTS OF A SEARCH FOR POINT SOURCES OF HIGH-ENERGY GAMMA RAYS. Vladimirskii, B. M.; Pavlov, I. V.; Stepanyan, A. A.; Fomin, V. P. (Crimean Astrophysical Observatory, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 1-6(1972).

Translated from Astron. Zh.; 49: No. 1, 3-10(1972).

A brief description is given of the Crimean Astrophysical Observatory facility for counting Cherenkov bursts from extensive air showers. The installation comprises two independent detectors employing four 1.5-m parabolic mirrors with photomultipliers at their foci. The resolution time of the coincidence circuit is 5 nsec. Two years of observations of the pulsar CP 1133 are reported and compared with other data. The positive result published previously is no longer considered definite. In the Cygnus region a flux of high-energy γ-ray photons ($E_\gamma > 2.5 \cdot 10^{12}$ eV) is observed from the galactic equator; the excess flux density is $\approx 2 \cdot 10^{-11}$ cm^{-2} $\cdot$ sec^{-1} (3.7σ). The angular size of the source, projected along the galactic meridian, is ≈3°. The flux of high-energy γ rays is estimated for photons assumed to be generated through inverse Compton scattering of cosmic-ray electrons by the 8°K infrared background. The observed flux is comparable to this theoretical value. (auth)

56953 COMPTON SCATTERING BY THERMAL ELECTRONS IN X-RAY SOURCES. Illarionov, A. F.; Syunyaev, R. A. (Inst. of Applied Mathematics, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 45-55(1972).

Translated from Astron. Zh.: 49: No. 1, 58-73(1972).

If a thermal x-ray source has a large optical depth relative to Thomson scattering, with $\tau_T > (m_e c^2/kT_e)^{1/2}$, its spectrum will differ strongly from the bremsstrahlung spectrum of a hot optically thin plasma. The energy exchange between plasma and radiation through Compton interactions is responsible for this difference. The spectrum of a hard x-ray source surrounded by a cool ($kT_e \ll h\nu$) ionized plasma with large τ_T will be severely distorted. Analytic expressions are obtained for the spectrum, including relativistic corrections. (auth)

56954 QUASARS AS IMAGES OF SEYFERT NUCLEI. de Silva, L. N. K. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 159: No. 2, 219-31(1972).

Treating a galaxy as a concentrated mass deflector (gravitational lens) acting in the manner discussed by previous writers, and first treating space as Euclidean, an expression is derived for the probability of finding a deflecting galaxy between the observer and a radiating source that produces at least intensification I of the apparent brightness of the source. Barnothy and Barnothy have suggested that QSOs might be images of Seyfert nuclei intensified in this way. Taking I = 100 as appropriate to this application, the expression shows that the ratio of the resulting number of observable QSOs to the number of observable Seyfert galaxies would be at most only about 3.3×10^{-7}; the value of the ratio inferred from actual observations is about 10^{-4}. The work is then extended so as to apply to any cosmological model described by a Robertson–Walker metric. Explicit results are shown graphically for four particular models; in all cases the cosmological treatment is less favorable than the classical to the suggested explanation of QSO phenomenon. It is remarked that the geometry of the foregoing work is such that in most cases of interest the radiation producing the intensified image according to the calculations would in fact traverse the body of the deflecting galaxy. (auth)

56955 ON IDENTIFYING NEW KINDS OF ASTRONOMICAL OBJECTS. Margon, B.; Bowyer, S.; Lampton, M.; Cruddace, R. (Univ. of California, Berkeley). Nature (London) Phys. Sci.; 238: No. 84, 92-3(7 Aug 1972).

A reply to the comments of Bahcall and Vahil (Nature (London) Phys. Sci.; 238: No. 84, 92(7 Aug 1972)) is presented. (W.D.M.)

56956 ON IDENTIFYING NEW KINDS OF ASTRONOMICAL OBJECTS. Bahcall, J. N.; Yahil, A. (Inst. for Advanced Study, Princeton, N. J.). Nature (London) Phys. Sci.; 238: No. 84, 92(7 Aug 1972).

Attention is drawn to a statistical problem that arises when the data from a number of new sources are analyzed to look for evidence for a particular kind of object, such as a neutron star for a "black hole." A statistical analysis of the data on any particular source must include consideration of the data on other sources found. An astronomical example occurs when it is claimed that evidence has been found for a compact x-ray source, possibly a neutron star. In this connection reference is made to Margon and others (Astrophys. J. Lett. 169: L45(1971)). (UK)

56957 SEARCH FOR HIGH FREQUENCY OPTICAL VARIABILITY IN X-RAY SOURCES. Richer, H. B.; Auman, J. R.; Isherwood, B. C.; Steele, J. P.; Ulrych, T. J. (British Columbia Univ., Vancouver). Nature (London) Phys. Sci.; 238: No. 87, 131-2(28 Aug 1972).

Searches were made in the optical region for variability on very short time scales of the x-ray sources Cyg X-1, Sco X-1, and X Per, in March 1972, using the Kitt Peak No. 2 36-inch telescope. Negative results were obtained. A pulse counting photometer was employed to count the number of photons received in a time interval of 0.010 sec. The data were handled by a small on-line computer and recorded on magnetic tape for analysis. Negative results were also obtained for longer term variability, up to ~10 min. It was concluded that the observations showed no frequency periodicity with an upper limit of about 0.005 meg. (UK)

56958 NATURE OF EVOLUTIONARY EFFECTS CONNECTED WITH QUASI-STELLAR RADIO SOURCES. II. Arakelyan, M. A. (Byurakan Astrophysical Observatory, USSR). Astrophysics; 5: No. 4, 308-17(1969).

Translated from Astrofizika; 5: No. 4, 603-14(1969).

Data of the Parkes Survey were used to investigate evolutionary effects associated with quasi-stellar radio sources, and the results are given. The conclusion by Arakelyan (1969) that quasi-stellar radio sources are uniformly distributed in the co-moving volume and have constant optical and evolving radio luminosities is confirmed. (auth)

56959 REALITY OF THE ~165-S PERIOD IN THE VARIATION OF SCO X-1. Gribbin, J. Mon. Notic. Roy. Astron. Sco.; 159: No. 2, 1P-2P(1972).

The peak found at ~165 s in power spectra of the optical flickering of Sco X-1 by both Gribbin et al (Nature 225; 1123 (1970)) and by Robinson & Warner (Mon. Not. R. Astr. Soc.; 157,85 (1972)) may after all represent a real, repeatable physical phenomenon. If so, it provides an important clue to the nature of the source. (auth)

56960 OBSERVATIONS OF RECOMBINATION LINES AT DECIMETRE WAVELENGTHS. Pedlar, A.; Davies, R. D. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 159: No. 2, 129-53(1972).

Recombination lines from a total of 15 H II regions were measured in the 166α (1424.734 MHz), 192α (921.897 MHz), and 220α (613.405 MHz) transitions. A description is given of the observational and reduction techniques; the spectra of all the observed lines are given. The data from these observations taken with published results of other transitions were used to derive some of the physical parameters of the H II regions studied. The following deductions were made from the observations: (1) Electron temperatures in the range 4000 to 7000°K were derived for the low-emission measure H II regions, values significantly less than those of the higher brightness objects. (2) The non-LTE analysis of Hjellming and Davies was found to fit the present high quantum number data with only minor modifications. (3) An apparently lower He/H line ratio for some 220α observations compared with lower observations is discussed in terms of possible ionization zoning in H II regions. (4) The observed line broadening suggests that supersonic velocities occur in most of the H II regions studied. (5) The line attributed to carbon increases monotonically relative to the hydrogen line as the quantum number increases to 220. (auth)

56961 RADIO GALAXIES, QUASARS, AND COSMOLOGY. Kellermann, K. I. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astron. J.; 77: No. 7, 531-42(Sep 1972).

This paper discusses the role of radio observations of galaxies and quasars in observational cosmology. Particular emphasis is given to the interpretation of radio-source counts, and it is concluded that when properly analyzed, the counts are not a function of wavelength, and that the claims for a large observed excess of weak sources have been greatly exaggerated. Evidence for a non-uniform spatial distribution of radio sources is inconclusive, and rests on (a) the significance of a small deficiency of relatively strong sources, (b) the nature of the unidentified sources, and (c) whether or not quasar red shifts are in fact of cosmological origin The rather pronounced change in number density observed between 5 and 10 sources sr^{-1}, the apparent nonuniform angular distribution, and the absence of any observed spectral index-flux density relation suggest that the data may not be cosmologically relevant. In particular, the radio-source counts do not provide evidence for cosmic evolution independent of the distribution of quasar red shifts. The dependence of observed angular size of radio sources on flux density and red shift is also examined, and it appears to reflect an apparent change in linear dimensions with red shift, rather than the effect of space curvature, and appears to be of little value in distinguishing between various world models. Finally, the apparent "super-light" motions of quasar components are discussed and it is concluded that the simplest explanation of the data suggests that the sources are nearer than indicated by their red shift, and that either the motions are nonrelativistic or there are no real motions at all and only variations in the intensity of one or more stationary components. (auth)

56962 OPTICAL IDENTIFICATION OF OHIO SURVEY RADIO SOURCES. Gearhart, Mirjana R.; Lund, James M.; Frantz, David J.; Kraus, John D. (Ohio State Univ., Columbus). Astron. J.; 77: No. 7, 557-9(Sep 1972).

Tentative optical identifications are made for 47 Ohio survey sources, many of which have flat or unusual radio spectra. Finding charts are provided for the identifications. Twenty-eight of the identifications are with stellar objects, 18 with galaxies, and 1 is a blank field. (auth)

56963 QUASAR REDSHIFTS. TRUE OR FALSE. Sanitt, N. (Inst. of Theoretical Astronomy, Cambridge, Eng.). New Sci.; 55: No. 812, 494-6(21 Sep 1972).

The most heated debate in physical cosmology during the past decade has concerned the large redshifts of the quasars. Are these objects really at the observable limit of the expanding universe? This interpretation has been challenged several times recently but remains relatively unscathed. (auth)(UK)

56964 OCCULTATION OF SGR A. Krishna, G.; Swarup, G.; Sarma, N. V. G.; Joshi M. N. (Tata Inst. of Fundamental Research, Bombay). Nature (London); 239: No. 5367, 91-3(8 Sep 1972).

Interferometric and lunar occultation observations show that the radio source Sgr A, which is located near the galactic center, consists of several components varying in size from a few arc seconds to a few arc minutes. Lunar occultation observations made at Ootacamund on September 9, 1970, have provided detailed information on the structure of the source of 327 MHz and have revealed the presence of an extended component 10 × 4 arc min in size and centered approximately on Sgr A. The extended source has an inclination of 45° ± 15° to the galactic plane, similar to that of the 20 cm continuum ridges. The observations were made using the Ooty radio telescope operating at 327 MHz with a bandwith of 4 MHz and a time constant of 1 s. (UK)

56965 FARADAY DEPOLARIZATION OF EXTRAGALACTIC RADIO SOURCES. Strom, R. G. (Sterrewacht, Leiden). Nature (London) Phys. Sci.; 239: No. 89, 19-21(11 Sep 1972).

It is stated that polarization observations indicate that the Faraday depth decreases with increasing size and support the view that quasars have strictly cosmological redshifts. (auth) (UK)

56966 BRIGHTNESS DISTRIBUTION AND POLARIZATION OF 3C 273. Conway, R. G.; Stannard, D. (Univ. of Manchester, Eng.). Nature (London) Phys. Sci.; 239: No. 89, 22-3(11 Sep 1972).

Interferometric observations at 73 cm made at Jodrell Bank and at 11 cm at the National Radio Astronomy Observatory, Greenbank, were examined. The data were assembled as one-dimensional arrays and direct Fourier inversion of the arrays provided strip distribution of the brightness and linear polarization at each wavelength. The radio source is double, and it was confirmed that while component A has a normal spectral index, the spectrum of component B is inverted. The most interesting feature of the distributions concerns the run of the position angle of the linear polarization along component A. The structure of the polarization is shown schematically. The orientation of the magnetic field is parallel to the major axis at the inner end of component A, but nearly perpendicular at the tip of the component. Such a structure is predicted both by the "magnetic loop" theory and the ram-pressure model, but not hitherto confirmed observationally. (UK)

56967 SCINTILLATION OF EXTENDED RADIO SOURCES WHEN THE RECEIVER HAS A FINITE BANDWIDTH. III. FURTHER METHODS. Budden, K. G.; Uscinski, B. J. (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), Ser. A; 330: No. 1580, 65-77(26 Sep 1972).

In previous work (Budden and Uscinski, Proc. Roy. Soc. Lond. A. 316; 315 (1970), and 321; 15 (1971)) the theory of the scintillation of the signal from a radio star when the intervening medium is weakly scattering but so thick that the effect of multiple scatter cannot be ignored was given. Allowance was made for the finite angular size of the source and the finite receiver bandwidth. New methods of solution of this problem are now presented which avoid some of the limitations of the solutions used earlier. The method is also extended to deal with the case where the scattering medium varies along the line of sight. (auth)(UK)

56968 EXCITATION OF A C II LINE OBSERVED IN QUASARS. Jackson, A. R. G. (University Coll., London). J. Phys., B (London); 5: No. 5, L83-6(May 1972).

The collision strength for the transition C^+ $2s^22p$ $^2P^0 - 2s2p^2$ ^4P was calculated from solutions of coupled integro-differential equations. Configuration interaction between $2s^22p$ and $2p^3$ was allowed for in the $^2P^0$ ground state. All $2s2p^2$ channels were included. The results have important applications for the interpretation of quasar spectra. (auth)

56969 SEARCH FOR CIRCULAR POLARIZATION IN EXTRAGALACTIC OBJECTS; Nordsieck, K. H. (Univ. of California, Santa Cruz). Astrophys. Lett.; 12: No. 2, 69-74(Oct 1972).

No significant circular polarization (less than 0.15 to 0.30%) has been found in the ultraviolet radiation of the nuclei of the Seyfert galaxies NGC 1068 and NGC 4151, and the QSO 3C 273. The variable object OJ 287 has shown linear polarization of up to 14%, variable on a time scale of one day, with a possible (2.5 σ) circular polarization of –0.9% on one day. (auth)

56970 FORMALDEHYDE ABSORPTION OF W33. Gardner, F. F.; Whiteoak, J. G. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astrophys. Lett.; 12: No. 2, 107-12(Oct 1972).

An investigation of the H_2CO absorption across the radio source W33 shows features at the velocities 12, 35, 52, and 61 km/sec. The 12 km/sec absorption appears to be associated with a lane of interstellar dust and arises in the solar neighborhood. The 35 km/sec absorption is associated with the main continuum peak G 12.8 – 0.2 and the OH position W33A. In the latter position the absorption is "anomalous". The absorption at 52 km/sec is concentrated over the OH center W33B and is also present at the ends of the major axis of the continuum distribution, but has a minimum against G 12.8 – 0.2. The 61 km/sec feature occurs near W33B. The results are interpreted in terms either of an expanding continuum source with surrounding molecular cloud, or of several cloud-continuum complexes at different distances. (auth)

56971 85α RECOMBINATION LINE SURVEY OF THE ORION NEBULA. Doherty, L. H.; Higgs, L. A.; Macleod, J. M. (National Research Council of Canada, Ottawa). Astrophys. Lett.; 12: No. 2, 91-8(Oct 1972).

Observations of the 85α (10,522 MHz) recombination lines of hydrogen, helium, and carbon were obtained at a grid of 49 points in the Orion Nebula. The variations across the nebula of radial velocity, electron temperature, hydrogen line width, and ionized helium abundance are presented in the form of contour diagrams. The distribution of ionized carbon is discussed. (auth)

56972 ACCURATE POSITIONS FOR RADIO SOURCES. Cohen, M. H. (California Inst. of Tech., Pasadena). Astrophys. Lett.; 12: No. 2, 81-5(Oct 1972).

Fringe-rate residuals from observations with the Goldstack interferometer ($d/\lambda = 10^8$ at 3.8 cm) were analyzed. The positions for eleven sources, and the baseline, were obtained to an accuracy of about 0.2 arc sec. Five sources were coincident with their associated optical objects to about 0.2 arc sec. (auth)

Solar Phenomena

Refer also to abstracts 57061 and 57209.

56973 Fe I IONIZATION AND EXCITATION EQUILIBRIUM IN THE SOLAR ATMOSPHERE. Athay, R. Grant; Lites, B. W. (National Center for Atmospheric Research, Boulder, Colo.). Astrophys. J.; 176: No. 3, 809-31(15 Sep 1972).

Computations for a 15-level model Fe I atom in the solar atmosphere indicate that many of the Fe I spectral lines are strongly influenced by departures from LTE. The strong lines originating from the ground term and low-lying metastable terms have a strong chromospheric contribution. Although for many of the lines the source functions saturate to the Planck function near the temperature minimum ($\tau_{5000} \approx 10^{-4}$) and lower, the ionization equilibrium does not saturate to the Saha condition until $\tau_{5000} \gtrsim 3 \times 10^{-3}$. The low-lying levels in Fe I reach maximum absolute populations near $\tau_{5000} = 3 \times 10^{-3}$, and lines originating from these levels tend to be formed at atmospheric depths where $\tau_{5000} \lesssim 3 \times 10^{-3}$. For high-excitation levels in Fe I, departures of the line source function from the Planck function extend deeper into the photosphere and may influence abundances derived from lines originating from these high lying levels. From the weakness of the principal Fe II lines in the far-ultraviolet (λ2599, in particular) relative to lines of Si II and Mg II it is suggested that the Fe II f-values of Corliss and Bozman are too high by a factor of the order of 10^2. Fe I photoionization from the lowest levels may be a significant source of opacity in the region 1600 to 2000 Å. (auth)

56974 FREE OSCILLATIONS OF THE SUN AND THEIR POSSIBLE STIMULATION BY SOLAR FLARES. Wolff, Charles L. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J.; 176: No. 3, 833-42(15 Sep 1972).

A large solar flare can raise the temperature of the underlying photosphere by 10%. The resulting thermal expansion exerts upon the solar interior a mechanical impulse whose kinetic energy is $\sim 10^{28}$ ergs. This will stimulate free modes of oscillation of the entire Sun, and the initial amplitudes of the more easily observable modes are calculated. Preliminary estimates of the effects of radiation damping and turbulent viscosity indicate that damping times will typically be longer than 1 day for the modes of most interest. (auth)

56975 ACCURATE CALCULATIONS OF WAVELENGTHS OF CERTAIN HELIUM-LIKE LINES IN THE X-RAY REGION. Ermolaev, A. M.; Jones, M.; Phillips, K. J. H. (Univ. Coll., London). Astrophys. Lett.; 12: No. 1, 53-6(Sep 1972).

Accurate calculations have been made of the wavelengths of certain lines in the helium-like ions Si XIII, Ca XIX, and Fe XXV, which have been observed in solar flares. The calculations include relativistic corrections and an estimate of the Lamb shift. The accuracy of the calculations is such that it is possible to indicate misidentifications of the line $2^3P_1-1^1S_0$ in Ca XIX and Fe XXV by Neupert. (auth)

56976 REDUCTION OF THE SOLAR NEUTRINO FLUX BY PRIMORDIAL ^{3}He IN THE SUN. Mitalas, Romas (Univ. of Western Ontario, London). Astrophys. Lett.; 12: No. 1, 35-6 (Sep 1972).

The presence of primordial ^{3}He in the sun would decrease the hydrogen burning age of the sun and would reduce the solar neutrino flux significantly. (auth)

56977 HORIZONTAL PROPAGATION OF SOLAR ATMOSPHERIC OSCILLATIONS. Thomas, John H.; Clark, Patricia Andre; Clark, Alfred Jr. (Univ. of Rochester, N. Y.). Astrophys. Lett.; 12: No. 1, 31-4 (Sep 1972).

The three basic types of resonant wave modes that have been proposed as the mechanism for solar five-minute oscillations have inherent differences in their horizontal propagation. Observations of horizontal propagation may help to identify the true mode of oscillation. (auth)

56978 CURRENT SHEETS IN CORONAL STREAMERS. Priest, E. R.; Smith, D. F. (National Center for Atomospheric Research, Boulder, Colo.). Astrophys. Lett.; 12: No. 1, 25-9 (Sep 1972).

The current sheet in a coronal streamer has been analyzed by Pneuman. An improvement to his model, in which the equations are solved in a more consistent manner, is presented here. As a result, the radial magnetic field drops off more rapidly with distance, the velocity at the base of the current sheet is larger, and the transverse magnetic field is significantly smaller than in Pneuman's model. (auth)

56979 SOME CHARACTERISITCS OF MICROWAVE TYPE IV RADIO BURSTS AND THE ACCELERATION OF SOLAR COSMIC RAYS. Sakurai, Kunitomo (Goddard Space Flight Center, Greenbelt, Md.). Publ. Astron. Soc. Pac.; 84: No. 500, 531-3 (Aug 1972).

The relationships between some characteristics of microwave Type IV radio bursts and solar protons of MeV energy are discussed. It is shown that the peak flux intensity of these bursts is almost linearly correlated with the MeV proton peak flux observed by satellites near the Earth. The rise times of Type IV microwave emissions are, however, independent of the proton peak fluxes. Using these results, discussion is given on the acceleration process and duration for both protons and electrons. (auth)

56980 (B–V) AND (U–B) COLOR INDICES OF THE SUN. Croft, S. K.; McNamara, D. H.; Feltz, Kent A. Jr. (Brigham Young Univ., Provo). Publ. Astron. Soc. Pac.; 84: No. 500, 515-18(Aug 1972).

Two photometric (khg) indices were measured for 42 F, G, and K luminosity class V stars and Uranus. The indices correlated well with the (B−V) and (U−B) values of the stars. The (khg) indices of Uranus were used to derive (B−V) and (U−B) values for the Sun. The results were $(B-V)_\odot = 0.631 \pm 0.003$m (p.e.) and $(U-B)_\odot = 0.14 \pm 0.007$m (p.e.). (auth)

56981 INFLUENCE OF RAMAN SCATTERING ON THE DISTRIBUTION OF MOLECULES OVER VIBRATIONAL LEVELS. Sarychev, A. P. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 170-1(1972).

Translated from Astron. Zh.; 49: No. 1, 214-16(1972).

An allowance for Raman scattering as a factor capable of disrupting the equilibrium distribution over vibrational levels of the molecules in the solar atmosphere does not alter the previous finding that the distribution indeed is nearly Boltzmann. (auth)

56982 OBSERVATION OF AN ERUPTIVE PHENOMENON IN THE SOLAR CORONA. Khetsuriani, Ts. S.; Tetruashvili, E. I. (Astrophysical Observatory, Tbilisi, USSR). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 168-9(1972).

Translated from Astron. Zh.; 49: No. 1, 213-14(1972).

The emergence and disappearance of a coronal formation was observed in the red and green coronal lines; its radial velocity was 15 and 12 km/sec, respectively. The phenomenon was identified with a surge observed in the Hα line on the AFR-2 instrument. (auth)

56983 MECHANISM FOR THE FORMATION OF SUNSPOTS. Ponomarenko, Yu. B. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 116-19(1972).

Translated from Astron. Zh.; 49: No. 1, 148-52(1972).

A mechanism is discussed whereby sunspots would result from the concentration of the magnetic flux of an active region. The concentration of flux and the formation of pores are accomplished in two stages. The flux is first concentrated at the corners of supergranules due to the motion of the supergranules; invisible pores form, within which supergranular and granular motion are suppressed. This suppression tends to cool and compress (heat and expand) the upper (lower) part of each pore; as a result, the invisible pore darkens and becomes visible. Sunspots are considered to be heated as a whole: The energy of heating in the lower part will exceed the energy of cooling in the upper part by the "deficiency" in radiative energy in a spot. Large spots form through merger of pores, a process induced by the motion of a giant granule. (auth)

56984 X RAYS FROM CORONAL CONDENSATIONS AND THE DEVELOPMENT OF ACTIVE REGIONS. Zhitnik, I. A.; Livshits, M. A. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 107-15(1972).

Translated from Astron. Zh.; 49: No. 1, 137-47(1972).

The hardness of the x rays from individual local sources on the Sun was compared, using heliograms obtained with the Cosmos 166 satellite when solar activity was relatively low. The flux at 550 such peaks in the heliograms was measured in the 8 to 14 and 2 to 8 Å passbands. The x rays for coronal condensations located above spot groups and above flocculi with no sunspots differed in hardness. An analysis of direct x-ray photographs and spectra (including the range 7 to 20 Å) obtained with the Vertical 1 rocket in 1970 confirmed that the production of a hard source (λ < 10 Å) accompanies a well-developed spot group at the corresponding activity center. Regions at a temperature $T > 3 \cdot 10^6$°K should accordingly occur in such a condensation. (auth)

56985 MULTIPLE-FREQUENCY OPERATION OF THE CULGOORA RADIOHELIOGRAPH. Sheridan, K. V.; Labrum, N. R.; Payten, W. J. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Nature (London) Phys. Sci.; 238: No. 86, 115-16(21 Aug 1972).

This instrument was initially designed to operate at 80 MHz. The addition of a second operating frequency of 160 MHz is here reported, together with work in progress to add a third frequency of 43.25 MHz. The new frequencies will permit the observation of plasma sources in the corona at nominal heights of 0.3 and 1 $R_\odot$ and a study of such sources through the depth of the corona, and will also allow the fundamental and second harmonic of the radiation to be received simultaneously, observations of importance in studies of the origin and propagation of the sources. A 160 MHz radioheliogram taken on May 15th, 1972 is reproduced, showing three sources, two being strongly polarized storm centers of spectral type 1 and the third an unpolarized type III burst. The use of combined observations at 80 and 160 MHz for studying the corona in depth is also illustrated, for a situation in which an optical flare was accompanied by a complex radio outburst. (UK)

56986 JET STREAMS AND THE DEVELOPMENT OF THE SOLAR SYSTEM. White, M. L. (Air Force Cambridge Research Labs., Bedford, Mass.). Nature (London) Phys. Sci.; 238: No. 85, 104-5(14 Aug 1972).

Hydrodynamic considerations show that jet streams can develop in a rotating gaseous disk only at certain discrete orbital distances, given by a geometric progression (α^n where α is a constant and n is integer). This progression is a good representation for the distance, from their parent body, of the planets (asteroid belt included) as well as the satellites of low inclination of Jupiter, Saturn and Uranus. The theory also yields streamlines which are logarithmic spirals and may be justifiably applied to the form and structure as well as the dynamics of hurricanes and spiral galaxies. (auth)

56987 POLAR MAGNETIC FIELDS OF THE SUN: 1960-1971. Howard, Robert (Carnegie Inst. of Washington, D. C.). Solar Phys.; 25: No. 1, 5-13(Jul 1972).

Observations of the magnetic fields in the polar regions of the Sun are presented for the period 1960—1971. At the start of this interval the fields at the two poles were consistently of opposite sign and averaged around 1 G. Early in 1961 the field in the south decreased suddenly and the field in the north decreased in strength slowly over the next few years. By the mid-1960's the fields at both poles were quite weak and irregular. Throughout the period of these observations the fields at both poles often showed a remarkable tendency to vary in unison. About the middle of 1971 the north polar field became significantly positive, first at lower latitudes, then above 70°. An autocorrelation analysis of the polar fields in the north shows a weak rotation peak, indicating significant "features" in these regions. A comparison of field strengths in the east and west quadrants in the north suggests that even at the extreme polar latitudes the following polarity fields are inclined slightly toward the rotation and the preceding polarity field lines are inclined slightly to trail the rotation. (auth)

56988 SOLAR ABUNDANCE OF CALCIUM AND COLLISION BROADENING OF Ca I- AND Ca II-FRAUNHOFER LINES BY HYDROGEN. Holweger, H. (Univ., Kiel). Solar Phys.; 25: No. 1, 14-29(Jul 1972).

An abundance analysis of the solar calcium spectrum was carried out using 46 lines with known f-values in the visible and near infrared spectral region. Resonance, forbidden, and autoionizing lines were included. The solar abundance of calcium resulting from the 25 weaker, nearly damping-independent lines only was $\log \epsilon_{Ca} = 6.36 \pm 0.07$, on the scale $\log \epsilon_H = 12$. The great variety of transitions involved in the solar calcium spectrum, ranging from 0 eV lines of Ca_I to 7.5 eV lines of Ca_{II} and including autoionizing lines, were in reasonable agreement. Therefore notable non-LTE effects on their equivalent widths could be excluded. Together with the sodium abundance $\log \epsilon_{Na} = 6.30$ determined earlier, the solar abundance ratio Ca/Na = 1.15 was obtained with an accuracy of ≈ 10%. Comparison with meteorites (carbonaceous chondrites I) showed that solar and meteoritic ratio agree within these limits. The line broadening by collisions with hydrogen atoms was determined empirically from a comparison of weak and strong Fraunhofer lines of Ca_I and Ca_{II}, thereby using the solar atmosphere as an absorption tube of comparatively well-known physical state. The damping half-widths γ_H turned out to be larger than predicted from pure van der Waals interaction, the average enhancement factor being 3.0 for Ca_I and 1.7 for Ca_{II}, independent of term properties to a first approximation. Regardless of the reason for this enhancement—inaccurate van der Waals theory or predominance of repulsive interaction—these results can be used in the spectroscopy of other stars. (auth)

56989 SOLAR ABUNDANCE OF SILVER. Ross, John E.; Aller, Lawrence H. (Univ. of California, Los Angeles). Solar Phys.; 25: No. 1, 30-43(Jul 1972).

Low-noise, high-resolution spectral scans were obtained for the resonance lines of silver γ3280.7 and γ3382.9, observed at the center of the solar disk. A double pass-monochromator was used in conjunction with the Snow telescope at Mount Wilson; the transparency of the sky was monitored during the observations in order to achieve required accuracy. The data were analyzed by the method of spectral synthesis wherein a model atmosphere resembling Elste's (1968) model was used and checked by limb-darkening observations. The kinematical model adopted a macroturbulent velocity of 2.2 km s^{-1} and no microturbulence. With this model line profiles could be reproduced without invoking implausibly large collisional damping constants. The silver abundance turned out to be $\{Ag\} = \log [N(Ag)/N(H)] + 12 = 0.85$, a factor of four under the value found from the Type I carbonaceous chondrites. (auth)

56990 SPECTRAL ANALYSES OF SOLAR PHOTOSPHERIC FLUCTUATIONS. III. BI-DIMENSIONAL POWER, COHERENCE AND PHASE SPECTRA OF DEEP-SEATED RADIAL VELOCITY AND PHOTOMETRIC FLUCTUATIONS. Edmonds, Frank N. Jr.; Webb, Carol J. (Univ. of Texas, Austin). Solar Phys.; 25: No. 1, 44-70(Jul 1972).

Fluctuations measured from a time sequence of high-resolution, high-dispersion Sacramento Peak Observatory spectrograms and previously analyzed by computing one-dimensional temporal and spatial spectra (Edmonds et al., 1965), were re-analyzed using bi-dimensional (temporal and spatial) power, coherence and phase spectra computed by fast-Fourier-transform techniques. The fluctuations measured were radial velocity for the Fe_I 5049.83, Cr_I 5051.91 and C_I 5052.16 spectral lines, continuum brightness, and equivalent width and central intensity of the C_I line. The bi-dimensional spectra, particularly those of coherence and phase, allowed isolating different components of the fluctuations to a degree not possible in the one-dimensional analyses. Six components of the fluctuations were isolated; the first three components were well-known but the nature of the remaining three was less certain. (W.D.M.)

56991 MICRO- AND MACROTURBULENT MOTIONS AND THE VELOCITY SPECTRUM OF THE SOLAR PHOTOSPHERE. De Jager, C. (Astronomical Inst., Utrecht). Solar Phys.; 25: No. 1, 71-80(Jul 1972).

A given motion field in a stellar atmosphere is usually observed through "filters" defined by line shifts and -broadenings and conventionally called macroturbulence and microturbulence. These "filters" can be defined and computed exactly, as a function of the wave number of the velocity field. The results were applied to several cases of an assumed motion field spectrum, and to observations of broadenings and displacements of solar Fraunhofer lines formed at a depth $\tau_5 = 0.1$. The results showed that virtually all energy of the photospheric motions at that level is contained in a small range of wavenumbers, corresponding to the observed distribution of granular cell diameters. In other words: a well-developed spectrum of hydrodynamical turbulence extending over a large range of wavelengths does not exist at that level of the photosphere. (auth)

56992 HIGH-RESOLUTION SPECTROSCOPY OF THE DISK CHROMOSPHERE. I. OBSERVING PROCEDURES. Beckers, J. M. (Sacramento Peak Observatory, Sunspot, N. Mex.); Mauter, H. A.; Mann, G. R.; Brown, D. R. Solar Phys.; 25: No. 1, 81-5 (Jul 1972).

The details of an extensive observing program are described which was aimed at the precise photometric observation of chromospheric fine structures in the 3933, 3968, 8498, and λ8542 lines of ionized calcium, the λ6563 line of hydrogen, and the 5890 and λ5896 lines of sodium. (auth)

56993 HIGH-RESOLUTION SPECTROSCOPY OF THE DISK CHROMOSPHERE. II. TIME SEQUENCE OBSERVATIONS OF Ca II H AND K EMISSIONS. Wilson, P. R. (Univ. of Sydney); Rees, D. E.; Beckers, J. M.; Brown, D. R. Solar Phys.; 25: No. 1, 86-97(Jul 1972).

Two independent sets of high-resolution time series spectra of the Ca_{II} H and K emission obtained at the Solar Tower and at the Big Dome of the Sacramento Peak Observatory on September 11, 1971 are reported. The evolutionary behavior of the emission first reported by Wilson and Evans is confirmed but the detail of the evolution is found to be more complex. In one case, a doubly peaked feature showing some K_3 emission evolves into a single K_2 (red) peak with no K_3 emission. Coincidentally, a neighboring doubly peaked feature evolves to a very strong blue peak. In an entirely independent sequence a doubly peaked feature evolves into a single red peak. The K_2 emission then fades completely although the continuum threads are still strong. Finally a strong K_2 blue peak appears. These developments are confirmed by intensity profiles obtained from the spectra. Image motion during the sequences is measured using slit-jaw photographs and changes in the overall pattern of the spectra. It is found to be less than the size of the individual features, i.e., 1 to 2". While considering that the evolution can be explained by the relative motion of one feature with respect to another during the sequence, it is shown that it is possible to account for all these examples in this way only by invoking coincidence of a very high order. It is concluded that in these cases the observed evolution of the K_2 emission is due to temporal variations in the physical conditions which give rise to them. (auth)

56994 OBSERVATIONS OF THE HORIZONTAL VELOCITY FIELD SURROUNDING SUNSPOTS. Sheeley, N. R. Jr. (Kitt Peak National Observatory, Tucson, Ariz.). Solar Phys.; 25: No. 1, 98-103(Jul 1972).

During the summer and fall of 1971, Doppler spectroheliograms were obtained for several sunspots located near the solar limb. These observations confirm a previous result based on the study of only a few sunspots that in the plage-free photosphere surrounding sunspots the spatially-averaged, horizontal flow tends to be outward at 0.5 to 1.0 km s^{-1} for distances typically 10000 to 20000 km beyond the outer boundary of the penumbra. It is suggested that these material motions are the means by which small-scale fragments of magnetic flux are carried away from sunspots. (auth)

56995 LINE INTENSITY RATIOS E(Hα)/E(D3) AND E(Hβ)/E(D3) IN PROMINENCES. Stellmacher, G. (Institut d'Astrophysique, Paris). Solar Phys.; 25: No. 1, 104-7(Jul 1972).

The intensity ratios E(Hα)/E(D3) and E(Hβ)/E(D3) in prominences depend on the total optical thickness in Hα of the layer. The emission of the He D3 line appears relatively enhanced in thin layers and in outer parts of the prominences. (auth)

56996 OBSERVATIONS OF PROMINENCES AT 3.5 MILLIMETER WAVELENGTH. Kundu, M. R. (Univ. of Maryland, College Park). Solar Phys.; 25: No. 1, 108-15(Jul 1972).

At 3.5 mm wavelength absorption features are observed in correspondence with Hα dark filaments on the disk; beyond the limb the prominences correspond to emissive regions. The absorption features are larger (2 to 3′ arc) than the corresponding Hα dark filaments; the emissive regions at the limb have similar angular sizes. The emissive regions at the limb have electron temperatures of 5500 ± 500 K; the amount of absorption observed on the disk leads to mean electron densities of about 5×10^{10} per cm^3. (auth)

56997 DERIVATION OF TEMPERATURE GRADIENT AND ELECTRON DENSITY MAPS FROM EUV SPECTROHELIOGRAMS. Withbroe, George L. (Harvard College Observatory, Cambridge, Mass.). Solar Phys.; 25: No. 1, 116-26(Jul 1972).

Spatial variations in electron density at the base of the corona and in the temperature gradient in the chromospheric—coronal transition layer as determined from analysis of maps constructed from Mg_X and O_{VI} spectroheliograms are discussed. Both the mapping techniques and results of analyzing euv spectra from OSO6 observations are presented. Comparisons of these maps with photospheric magnetograms and spectroheliograms made in chromospheric euv lines and continua indicate that the electron density and temperature gradient in the transition layer tend to be enhanced in areas where the photospheric magnetic field and chromospheric euv emission are enhanced. Relationships among the coronal electron density, transition-layer temperature gradient, chromospheric emission, and photospheric magnetic field strength are derived. (auth)

56998 PRACTICAL REPRESENTATION OF MAGNETIC FIELD. Nakagawa, Y.; Raadu, M. A. (National Center for Atmospheric Research, Boulder, Colo.). Solar Phys.; 25: No. 1, 127-35(Jul 1972).

Various manners of determination of a magnetic field are reviewed briefly from the standpoint of practicality and uniqueness. Then a practical representation of magnetic fields in terms of a class of force-free magnetic field is described. The proposed scheme is based on the physical consideration that in the chromosphere and lower corona a quasistatic magnetic field must be nearly force-free and that for the class of force-free magnetic field, i.e., $\nabla \times B = \alpha B$ with α = constant, the magnetic field can be determined uniquely from the observed distribution of the vertical component of a magnetic field. The applicability of the representation is demonstrated by examples and the limitations are discussed. (auth)

56999 SOME ASPECTS OF FLARE PROPERTIES VERSUS MAGNETIC BOUNDARY MORPHOLOGY. Prata, Stephen W. (Carnegie Inst. of Washington, D. C.). Solar Phys.; 25: No. 1, 136-40(Jul 1972).

Flares often begin near lines of zero-longitudinal magnetic field. These boundary lines between opposite polarities can have the magnetic field either parallel to or transverse to the boundary. A study of 75 flares associated with one or the other type of boundary indicates that the difference in boundary morphology is not reflected in the frequency or properties of the associated flares. (auth)

57000 FLARES AND CHANGING MAGNETIC FIELDS. Rust, David M. (Air Force Cambridge Research Labs., Sunspot, N. Mex.). Solar Phys.; 25: No. 1, 141-57(Jul 1972).

An observational study of maps of the longitudinal component of the photospheric fields in flaring active regions leads to the following conclusions: (1) The broad-wing Hα kernels characteristic of the impulsive phase of flares occur within 10″ of neutral lines encircling features of isolated magnetic polarity ("satellite sunspots"). (2) Photospheric field changes intimately associated with several importance 1 flares and one importance 2B flare are confined to satellite sunspots, which are small (10″ diam). They often correspond to spot pores in white-light photographs. (3) The field at these features appears to strengthen in the half hour just before the flares. During the flares the growth is reversed, the field drops and then recovers to its previous level. (4) The magnetic flux through flare-associated features changes by about 4×10^{19} Mx in a day. The features are the same as the "Structures Magnétiques Evolutives" of Martres et al. (1968a). (5) An upper limit of 10^{21} Mx is set for the total flux change through McMath Regions 10381 and 10385 as the result of the 2B flare of October 24, 1969. (6) Large spots in the regions investigated did not evince flux changes or large proper motions at flare time. (7) The results are taken to imply that the initial instability of a flare occurs at a neutral point, but the magnetic energy lost cannot yet be related to the total energy of the subsequent flare. (8) No unusual velocities are observed in the photosphere at flare time. (auth)

57001 DECAY CHARACTERISTICS OF MODELS OF SOLAR HARD X-RAY BURSTS. Brown, John C. (Univ. of Glasgow). Solar Phys.; 25: No. 1, 158-77(Jul 1972).

Models of solar hard x-ray bursts were considered in which nonthermal electrons are impulsively injected into a coronal magnetic trap. Recognizing that the ends of the trap are likely to be rooted in the photosphere and that the density of the ambient atmosphere may thus be highly nonuniform along the field lines, it is shown that the x-ray spectra will initially soften with time, due to collisions, when this nonuniformity is strong enough. This removes a well-known discrepancy in models with uniform density. It is shown also that nonuniformity steepens the electron spectrum required to produce a given observed x-ray spectrum. In consequence the total nonthermal electron energy involved in a given burst is greater than that previously inferred from impulsive injection models. (auth)

57002 HEATING OF THE SOLAR PLASMA DUE TO MICROWAVE PHENOMENA CORRELATED WITH TYPE II METER BURSTS. Fuerst, E. (Max-Planck-Institut fuer Radioastronomie, Bonn). Solar Phys.; 25: No. 1, 78-87(Jul 1972).

The heating of the solar plasma of those layers is considered where the microwave bursts are emitted. Phenomena correlated with the so-called Type II m bursts are considered. Bursts of this kind are excited by shock-waves initiated near the optical flare region. These shock waves spread out into the higher corona, and if the shock strength is sufficiently high, the microwave region is heated to 10^7 K. But this temperature is too low to explain the burst radiation. It is shown that at plasma temperatures about 10^7 K a fairly high number of electrons is accelerated by Alfvén waves to equivalent kinetic temperatures of about 10^8 K. It is assumed that the Alfvén waves are generated near the sunspots, and, therefore, the accelerated electrons run along the magnetic-field lines into the microwave source lying between the two spots of an assumed dipole field. Within this source, the considered electrons thermalize and, after a short time, the source reaches temperatures of 5×10^7 to 10^8 K. A plasma of this temperature with an electron density about 5×10^9 cm^{-3} and a magnetic induction of 300 G is optically thick even at frequencies about 10 GHz, because the gyromagnetic absorption is very high. (auth)

57003 POSSIBLY DIRECT MEASUREMENT OF CORONAL MAGNETIC FIELD STRENGTHS. Rosenberg, Hans (Astronomical Inst., Utrecht). Solar Phys.; 25: No. 1, 188-96(Jul 1972).

During a unique solar radio event on March 2, 1970, among very diverse features, a very regular pattern was observed in the solar radio spectrographic record between 220 and 320 MHz. The proposed explanation is emission by slightly relativistic electrons at the sum frequency of the plasma frequency ($\approx$160 MHz) and the lower harmonics of the local gyrofrequency (n from 3 to 10), rather than emission at pure harmonics of the gyrofrequency (n from 15 to 20). The derived magnetic field strengths range from 3 to 8 G, and can be determined very accurately. From the simultaneously occurring pulsating structure in the Type IV emission and the deduced magnetic field strength a typical size of the emitting region of 2 to 300 km is derived. (auth)

57004 TYPE III SOLAR NOISE OBSERVED BELOW 100 kHz ON OGO 3. I. DESCRIPTION OF EVENTS. Dunckel, N. (Stanford Univ., Calif.); Helliwell, R. A.; Vesecky, J. Solar Phys.; 25: No. 1, 197-209(Jul 1972).

Type III solar noise bursts were observed in the frequency range 25 to 100 kHz with the vlf detector on OGO 3. The bursts decreased in frequency from 100 kHz (the highest frequency of observation) to as low as 25 kHz in approximately 45 min. The intensity at 100 kHz increased for about 20 min then decayed over a period of approximately 1 h. The variation of the intensity with time became less regular at lower frequencies. Observed maximum intensities near 80 kHz ranged from 3×10^{-18} to 2×10^{-16} W m^{-2} Hz^{-1}. Bursts were predominantly associated with west-limb flares. Their commencement at 100 kHz tended to follow Type III bursts observed at 2 to 4 MHz by about 10 min. Observed drift rates and decay times corresponded roughly to those extrapolated from higher frequency measurements. Type III and the so-called "high-pass" noise bursts often occured simultaneously, presenting a problem in identification. The solar noise events could be distinguished by their relatively slow time variation, smooth spectrum, and low intensity. (auth)

57005 PECULIAR ABSORPTION AND EMISSION MICROSTRUCTURES IN THE TYPE IV SOLAR RADIO OUTBURST OF MARCH 2, 1970. Slottje, C. (Solar Radio Observatory, Nera, Netherlands). Solar Phys.; 25: No. 1, 210-31(Jul 1972).

The high-resolution dynamic spectrogram between 320 and 160 MHz of the Type IV event which started at 13:35 UT on the March 2, 1970 showed a remarkable richness of absorption–emission microstructures. These were morphologically analyzed into structure elements and patterns. The elements were normal and reversed intermediate drift bursts, called fiber bursts, medium band shortlived absorptions, broadband shortlived absorptions, broadband wedge shaped absorptions, and a type called tadpole. The patterns were the pulsating structure, sequences of broadband shortlived absorptions, and patterns of almost parallel lines called zebra patterns. During the event a border frequency of about 230 MHz played an important part, most clearly as a low frequency cut-off for the tadpole–zebra pattern and as a zone of phase change in the pulsating structure. The macrostructure of this event, shown in a composite dynamic spectrogram, reveals features in the decimetric wavelength region that are related with the appearance of tadpole patterns in the region between 220 and 320 MHz. (auth)

57006 QUASI-PERIODIC SOLAR RADIO PULSATIONS AT DECIMETRIC WAVELENGTHS. Gotwols, B. L. (Johns Hopkins Univ., Silver Spring, Md.). Solar Phys.; 25: No. 1, 232-6(Jul 1972).

Observations are reported of radio-pulsations at dm-wavelengths. The pulsations are quasi-periodic with a period of 0.5 s, they have a bandwidth >300 MHz and show up to a 50% enhancement of the underlying Type IV continuum. (auth)

57007 NONIMAGING APPROACH TO SOLAR OBLATENESS MEASUREMENTS. Janssens, T. J. (The Aerospace Corp., El Segundo, Calif.). Solar Phys.; 25: No. 1, 237-41(Jul 1972).

A design is presented for an instrument to measure solar oblateness without forming a solar image and having two identical prisms as the only optical elements. Feasibility calculations indicate that this might be sensitive and quite free from instrumental induced errors. (auth)

57008 ACCELERATION TIME OF PARTICLES IN THE SOLAR ATMOSPHERE. Velinov, P. I. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 4, 495-8(1972).

The acceleration time of particles in the solar atmosphere is examined quantitatively taking into account some acceleration mechanisms which are probably of major importance. (L.T.W.)

57009 RECENT SOLAR RESEARCH. Howard, Robert (Carnegie Institution of Washington, D. C.). Science; 177: No. 4055, 1157-63(29 Sep 1972).

Many aspects of the field of solar physics are described and some recent results are given. Topics discussed include the Sun as a source of activity, the Sun as a physical laboratory, and the Sun as a star. (W.D.M.)

Galaxies

Refer also to abstracts 56954, 56969, and 56986.

57010 INTERNAL DUST IN NEBULAE. III. NONISOTROPIC SCATTERING. Mathis, John S. (Univ. of Wisconsin, Madison). Astrophys. J.; 176: No. 3, 651-8(15 Sep 1972).

The equations of radiation transfer for spherical model nebulae, uniformly filled with dust except for a central hole, are solved numerically. The dust is assumed to have a forward-throwing Henyey–Greenstein phase function characterized by g, the average cosine of the angle between incident and scattered radiation. Values of g between 0.0 (isotropic scattering) and 0.75 are considered, and of albedo, $\tilde{\omega}$, between 0.4 and 1. The intensity of the emergent radiation which is emitted by the nebula is unaffected by g. The scattered starlight (1) has a bright aureole for large g, (2) falls off more rapidly at the limb for large g, and (3) has a g-dependent optical depth associated with a given scattered intensity. The flux of scattered starlight is given by a simple expression. The results are applied briefly to NGC 6514. The scatter in the observations, caused by deviations from spherical symmetry, is too large to permit an unambiguous determination of g, but the optical depth in Hβ is between 0.4 and 0.5, if $\tilde{\omega} = 0.6$, independently of g. (auth)

57011 ESTIMATION OF MASSES OF INDIVIDUAL GALAXIES IN CLUSTERS OF GALAXIES. Wolf, Richard A. (Rice Univ., Houston, Tex.); Bahcall, John N. Contract AT(11-1)-68. Astrophys. J.; 176: No. 3, 559-80(15 Sep 1972).

Expressions are derived for approximate limits on the mass of an individual galaxy or quasi-stellar object that is a member of a group or cluster of galaxies. Two different approaches are used: first, a perturbation method that yields approximate limits on the mass of any observed object in a cluster provided only that the positions of cluster galaxies around the unknown mass are measured and redshifts are known for several galaxies in the cluster; and second, an extension of Page's method that gives approximate mass limits for any bound pair of galaxies whose positions and redshifts are known. The uncertainties in the mass estimates, arising from both observational and statistical effects, are estimated analytically. An "upper estimate," 80% certain to be greater than the actual mass of the galaxy, can be obtained in every case. A "best guess," at least 50% certain to be greater than the actual mass of the galaxy, and a "lower estimate," 80% certain to be less than the actual galaxy mass, can be obtained in some cases. The analytically derived formulae for the upper, lower, and best-guess estimates are then verified by comparison with computer simulations of the dynamical evolution of clusters of galaxies, using the numerical methods of Aarseth. Estimates are made of the masses of NGC 6166 (≈3C 338), NGC 4874 and 4889 (the giant ellipticals near the center of the Coma cluster), B264, TON 256, PKS 2251 + 11, and 10 supergiant galaxies that have double nuclei. (auth)

57012 CLUSTER OF COMPACT GALAXIES Zw Cl 0152 + 33. Sargent, Wallace L. W. (California Inst. of Tech., Pasadena). Astrophys. J.; 176: No. 3, 581-6(15 Sep 1972).

Redshifts were determined for 14 seventeenth-magnitude, mostly red, compact galaxies which form an elongated system at the center of the cluster Zw Cl 0152 + 33. This cluster was discovered by Zwicky to contain a vast preponderance of compact galaxies and, in this respect, is very unusual. The mean redshift is 26,304 km s^{-1} and the apparent distance modulus of the cluster is $(m - M) = 38.2$. The brightest galaxy in the cluster, which is a compact galaxy according to Zwicky, has $M_p = -21.2$. All the observed galaxies except one have late-type absorption spectra; the remaining galaxy is blue and has an emission-line spectrum. It is argued that the galaxies in the elongated system do not form a linear chain, but are in a flattened system seen nearly edge-on. An application of the virial theorem is complicated by the fact that the galaxies on the outer parts of the region considered have a higher velocity dispersion σ_r than those in the center. As a result it is found that the center of the cluster is probably a bound system while the outer members are escaping from the cluster on a timescale of about 10^9 years. This is smaller by a factor of 100 than the estimated dynamical relaxation time in the cluster; as a result the overall dynamics of the cluster are not understood. (auth)

57013 LONGITUDE SURVEY OF RADIO RECOMBINATION LINES FROM THE DIFFUSE INTERSTELLAR MEDIUM. Gordon, M. A. (National Radio Astronomy Observatory, Green Bank, W. Va.); Cato, Torgny. Astrophys. J.; 176: No. 3, 587-96 (15 Sep 1972).

Observations of the H157α recombination line (1683.2 MHz), from regions of the galactic plane free of discrete radio sources, show the line radiation to come from a region spatially coincident with the zone of giant H II regions—a zone bounded by galactic radii of approximately 3 and 9 kpc. Within this zone, the observations determine the quantity $N_e N_{HII}/T_e^{1.5}$ to be approximately 5×10^{-6} cm^{-6} $°K^{-1.5}$. If the ionization is in statistical equilibrium, the net ionization rate appears to be at least 10^{-13} s^{-1}, compared to the value of 10^{-15} s^{-1} measured outside the zone by other methods. However, the ionization might also be produced by supernova events, in which case a given volume of gas should be exposed to the ultraviolet flash at least every 10^5 years. (auth)

57014 COLLISIONAL EXCITATION OF CARBON MONOXIDE IN INTERSTELLAR CLOUDS. Goldsmith, Paul F. (Univ. of California, Berkeley). Astrophys. J.; 176: No. 3, 597-610 (15 Sep 1972).

Different models for the collisional excitation of carbon monoxide (CO) were investigated by solving the rate equations for the 10 lowest energy levels, including stimulated emission and absorption by 3°K isotropic radiation, spontaneous emission, and collisions. The results are qualitatively applicable to other linear molecules. They show that a wide range of rotational excitation temperatures, including population inversions, can be produced by the various kinetic temperatures and particle densities which are likely to occur in the interstellar regions containing molecules. (auth)

57015 INFRARED PHOTOMETRY OF EXTRAGALACTIC SOURCES. Rieke, G. H.; Low, F. J. (Univ. of Arizona, Tucson). Astrophys. J.; 176: No. 3, L95-100(15 Sep 1972).

Observations of 57 extragalactic sources at 10 μ are presented. Several of the brightest sources were observed from 2 to 25 μ. The observed range of lower limits to the infrared luminosities for galaxies extends from 10^{32} to 10^{38} watts. The infrared and radio spectra of the nuclei in Seyfert and related galaxies appear to be causally related. (auth)

57016 STRUCTURE OF SMALL SOURCES IN M51 AT 2695 MHz. Spencer, J. H.; Burke, B. F. (Massachusetts Inst. of Tech., Cambridge). Astrophys. J.; 176: No. 3, L101-4(15 Sep 1972).

M51 was mapped at 2695 MHz using one configuration of the NRAO three-element interferometer. Fluxes, spectral index, and structure of four discrete sources were obtained. The nucleus of M51 was resolved into a complex that strongly resembles the nuclear regions of our own Galaxy. (auth)

57017 ROLE OF GASEOUS DISSIPATION IN DENSITY WAVES OF FINITE AMPLITUDE. Roberts, William W. Jr. (Univ. of Virginia, Charlottesville); Shu, Frank H. Astrophys. Lett.; 12: No. 1, 49-52(Sep 1972).

The estimate by Kalnajs of 0.8 to 1.5 × 10^8 yr for the time of "damping" of spiral density waves by their induced shocks in the interstellar gas conveys an important qualitative concept. However, part of his discussion is in error inasmuch as it is based on invalid considerations of energy transfer. This letter gives a derivation of the dissipative effects of galactic shocks based on the application of Bernoulli's theorem to the problem of the angular momentum interaction. In an approximation which ignores the effects of the convective transport and of the interactions with the basic state, a value for the "damping time," $\sim 10^9$ yr, which is comparable to the "propagation time" for a group of spiral waves is estimated. (auth)

57018 COMPUTER STUDY OF GALACTIC SPIRAL ARMS. Barricelli, Nils Aall; Havnes, Ove; Hemphil, John, Boelviken, Erik (Univ. of Oslo). Astrophys. Lett.; 12: No. 1, 37-41 (Sep 1972).

Results obtained in a computer study of the formation of galactic spiral arms are presented. The explosion theory was adopted, according to which the material that forms the arms is supposed to have been ejected from the galactic nucleus. (auth)

57019 VARIATIONS IN THE NUCLEAR LUMINOSITIES OF THE SEYFERT GALAXIES NGC 3516 AND 5548. De Vaucouleurs, G.; De Vaucouleurs, A. (Texas Univ., Austin). Astrophys. Lett.; 12: No. 1, 1-4(Sep 1972).

Variations in the nuclear luminosities of the Seyfert galaxies NGC 3516 and 5548 are demonstrated by U, B, V photometry at McDonald Observatory between 1968 and 1972, supplemented by earlier data. Estimates of the variable magnitude B_N of the quasi-stellar nucleus and of the constant total magnitude B_T^* of the stellar component of the galaxy (excluding the nucleus) are, for NGC 3516, $B_T^* \simeq 12.4$, $B_N = 14.2$ (1958) to 15.0 (1968), with a flare up to $B_N \simeq 13.8$ in March 1972 accompanied by a considerable increase in the ultraviolet flux; and, for NGC 5548, $B_T^* \simeq 13.1$, $B_N = 14.7$ (1968) to 15.7 (1971–72). Absolute magnitudes are derived from distance moduli inferred for radial velocities (N3516, $m_0 - M = 31.7$; N5548, $m_0 - M = 32.9$). Both galaxies are brighter than average for their morphological type with total magnitude $\langle M_T^*(B) \rangle \simeq -20$ for the stellar component and $-18.5 < M_N(B) < -17.0$ for the quasi-stellar nucleus. (auth)

57020 MEASUREMENT OF THE INTERSTELLAR $^{12}C/^{13}C$ RATIO. Vanden Bout, Paul A. (Univ. of Texas, Austin). Astrophys. J.; 176: No. 3, L127-9(15 Sep 1972).

The $\lambda 4232$ line of $^{13}CH^+$ was detected photoelectrically in the interstellar line spectrum of ζ Oph. The equivalent width of this line is 0.35 ± 0.10 mÅ; comparison with the strength of 22.3 ± 0.4 mÅ of the $^{12}CH^+$ line yields $a \equiv {}^{12}C/{}^{13}C = 75\ (+25, -15)$. (auth)

57021 DISCOVERY OF INTERSTELLAR CIRCULAR POLARIZATION IN THE DIRECTION OF THE CRAB NEBULA. Martin, P. G.; Illing, R.; Angel, J. R. P. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 159: No. 2, 191-201(1972).

A search in many small regions of the Crab Nebula resulted in the detection of a small component of circular polarization. The variation of the sign and magnitude with position in the Nebula indicates that the polarization is of interstellar origin. On the basis of the polarity, strength, and color dependence, it is concluded that the composition of the aligned grains causing this polarization is dielectric. Metallic particles are clearly ruled out. Some stars were also observed with negative results. (auth)

57022 INTERSTELLAR CIRCULAR POLARIZATION. Martin, P. G. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 159: No. 2, 179-90(1972).

It is shown that optical observations of circular polarization produced by aligned interstellar grains could yield valuable information about the grain material. The interstellar medium is known to be linearly dichroic from observations of interstellar linear polarization; many different grain models using a large variety of compositions can be found to reproduce these observations. Since the same aligned grains make the medium linearly birefringent, a small component of circular polarization can result from incident linearly polarized light if the position angle of the linear polarization does not coincide with either principal axis of the medium. Calculations are presented to demonstrate that the wavelength of the circular polarization is sensitive to the imaginary part of the complex refractive index of the grain material. This provides an opportunity of investigating whether the grains are characteristically dielectric or metallic. Some possible observations are suggested. (auth)

57023 COSMOLOGICAL EVOLUTION OF RADIO SOURCES OF LARGE ANGULAR EXTENT. Fanaroff, B. L.; Longair, M. S. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 159: No. 2, 119-28(1972).

The number of radio sources of large angular size ($O \geq 60''$) found in a survey of sources having $0.5 < S_{408} < 5 \times 10^{-26} Wm^{-2} Hz^{-1}$ by Windram and Kenderdine (1969) is compared with the number expected in different world models. An excess of such sources is found in comparison with the predictions of uniform models but their number is consistent with the postulate that such sources exhibit a moderate rate of evolution. In a complete sample of ${}_5C$ sources at much lower flux densities, $S_{1400} \geq 0.01 \times 10^{-26} Wm^{-2}Hz^{-1}$, there is an excess of sources having steep spectra and a correlation is found between these sources and those of large angular size. A model is proposed in which these sources are associated with relatively weak radio galaxies with long lifetimes. The steepening of the radio spectra is ascribed to inverse Compton losses due to scattering of the microwave background. The model enables the lifetimes of individual radio source events to be estimated. (auth)

57024 UPPER LIMITS ON THE ATOMIC HYDROGEN ABUNDANCE IN 12 GLOBULAR CLUSTERS. Kerr, F. J.; Knapp, G. R. (Univ. of Maryland, College Park). Astron. J.; 77: No. 7, 573-83(Sep 1972).

A search was made with the NRAO 140-ft telescope for 21-cm line emission from 12 globular clusters, with negative results. These observations yielded limits on the atomic hydrogen content ranging from 11 $M_\odot$ for M4 to 85 $M_\odot$ for M15, and gave an average value for the galactic H I gas-to-dust ratio in the directions of the clusters of 1.6×10^{21} atom cm^{-2} mag^{-1}. (auth)

57025 BLUE EMISSION-LINE GALAXIES IN RICH CLUSTERS. Chincarini, Guido (Texas Univ., Austin); Rood, Herbert J. Publ. Astron. Soc. Pac.; 84: No. 500, 589-91(Aug 1972).

Blue galaxies selected from lists of color indices by Philip and Sanduleak contain emission lines in their spectra. Several are spiral and irregular members of rich regular clusters. (auth)

57026 TWO GALAXIES DOMINATED BY BRIGHT ULTRAVIOLET KNOTS. Braccesi, A. (Laboratorio di Radiastronomia, Bologna); Formiggini, L.; Gioia, I.; Sargent, W. L. W. Publ. Astron. Soc. Pac.; 84: No. 500, 592-3(Aug 1972).

During an inspection of the galaxies located in ten Palomar Sky Survey fields it was noticed that some galaxies were dominated by one or two bright ultraviolet knots. Two of these galaxies, Anon 09h47.4m + 31°43′ and Anon 12h42.1m + 28°45′, were observed spectroscopically. (W.D.M.)

57027 SEARCH FOR H I IN ELLIPTICAL GALAXIES. Gallagher III, John S. (Univ. of Wisconsin, Madison). Astron. J.; 77: No. 7, 568-72(Sep 1972).

A search has been made for 21-cm emission from neutral hydrogen in the normal elliptical galaxies NGC 2768, NGC 4125, NGC 4278, and NGC 4472 using the NRAO 140-ft telescope. None of the galaxies were definitely detected and upper limits on the order of several times 10^8 $M_\odot$ are set for the mass of optically thin neutral hydrogen. The implications of these upper-limit masses are briefly discussed in terms of the mass balance of the interstellar medium in elliptical galaxies. (auth)

57028 INTERSTELLAR REDDENING NEAR THE NORTH GALACTIC POLE. Feltz, Kent A. Jr. (Brigham Young Univ., Provo, Utah). Publ. Astron. Soc. Pac.; 84: No. 500, 497-514 (Aug 1972).

Color excesses were obtained for 182 B, A, and F stars within about 20° of the north galactic pole with the aid of BV, uvbyβ, and (khg) photometry. The average value of the reddening in the vicinity of the pole was found to be 0.000 ± 0.002m. Some structure of the interstellar medium is suggested by the data, but, for the most part, the amount of dust in the direction of the NGP is not sufficient to produce measurable reddening. (auth)

57029 ABSORPTION OF LIGHT IN GALAXIES. Fesenko, B. I. (Pskov Pedagogical Inst., USSR). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 74-8(1972).

Translated from Astron. Zh.; 49: No. 1, 97-101(1972).

Four statistical methods are discussed for evaluating self-absorption in galaxies of known inclination. An analysis of the Morphological Catalog of Galaxies yields the following values for the drop in the apparent brightness of high-inclination galaxies relative to galaxies of Vorontsov–Vel'yaminov's inclination Types I and II: Type III, +0.30 ± 0.069m; IV, +0.53 ± 0.075m; V, +0.83 ± 0.075m. The apparent galaxy diameters are independent of inclination. The absolute-magnitude distribution of the objects studied has a median of –19.8m with an interquartile range of 1.6m. The following probable lower limits are determined statistically for the range in the inclination angle of the galaxy axis corresponding to types I–V: 0, 40.0, 59.2, 73.8, and 80.3°. (auth)

57030 RADIO SOURCES IN NORMAL GALAXIES. Kuril'chik, V. N.; Komarov, N. A. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 64-70(1972).

Translated from Astron. Zh.; 49: No. 1, 85-92(1972).

An analysis of the radio spectra of nearby spiral galaxies indicates that the distribution of spectral indices α (defined by $F_\nu \propto \nu^{-\alpha}$) has prominent peaks at $\alpha_s \approx 0.6$ and $\alpha_L \approx 1.1$ (hence $\Delta\alpha \approx 0.5$). A classification of observed radio spectra is presented. At the frequencies investigated, radio sources in galaxies generally have two main components with different spectra. Type L spectra are typical of extended substructures whose radio diameter has an average ratio $r/o \approx 1.5$ to the optical diameter of the galaxy; type S spectra typify central substructures having $r/o \approx 0.2$ to 0.3. The differing spectra of central and extended substructures account for the observed reduction in the effective angular size of the radio sources in spiral galaxies toward higher frequencies. The behavior of the radio spectra of substructures does not conflict with the possibility that their relativistic electrons may have a unified power-law energy spectrum with a regular knee in the curve ($\overline{\gamma_S} = 2.2$, $\overline{\gamma_L} = 3.2$, $\overline{\Delta_\gamma} = 1$), but the magnetic-field strength in the two types of substructure should then differ by about an order of magnitude. Probably the substructures represent regions where relativistic electrons are in transit; thus, there would be a quasisteady flow of electrons out of the substructures. This escape could be by diffusion, either alone or accompanied by some regular motion along fragments of the regular magnetic field of the substructures. An improved diagram for radio luminosity as a function of surface brightness of the structures is presented. This diagram does not reflect a simple evolutionary track for a radio source in a galaxy, or the evolution of individual substructures; instead, it probably represents a sequence of states. (auth)

57031 GALAXIES WITH COMPLEX BLUE NUCLEI. Vorontsov-Vel'yaminov, B. A.; Zaitseva, G. V.; Lyutyi, V. M. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 71-3(1972).

Translated from Astron. Zh.; 49: No. 1, 93-6(1972).

The cosmological significance is emphasized for configurations where a region comprising the relatively cool stars in the inner part of the flat subsystem of a galaxy contains within it a nuclear region consisting of hotter, blue stars. Often the nuclear region exhibits ring or spiral structure; it forms a miniature "galaxy" of hot young stars inside the large galaxy, whose stars adjacent to the nuclear region are cooler and older than the stars within that region. The blue color of these nuclear regions is confirmed by UBV photometry. Spectroscopic observations, however, do not reveal much gas. The physical parameters of some nuclei are evaluated, and a list of galaxies with complex blue nuclei is given. (auth)

57032 INVESTIGATION OF SEVERAL NEBULAE IN CASSIOPEIA WITH A FABRY–PEROT INTERFEROMETER. Doroshenko, V. T.; Grachev, N. I. Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 87-90(1972).

Translated from Astron. Zh.; 49: No. 1, 110-14(1972).

Photographic and photoelectric scanning Fabry–Perot interferometers were used to determine profiles and half-widths of the H_α and H_β emission lines and radial velocities of several nebulae in Cassiopeia. The line profiles were Gaussian with half-widths of ≈40 to 45 km/sec. The following mean radial velocities were derived, corrected for the Earth's motion and standard solar motion: SG 13, $V_r = -52.6$ km/sec; SG 17 and 19, $V_r = -41.4$ km/sec; SG 272, $V_r = -39.9$ km/sec; NGC 7635, $V_r = -44.0$ km/sec; S 158, $V_r = -54.2$ km/sec. (auth)

57033 STRUCTURE OF A QUASISTATIONARY SPHERICAL SYSTEM OF STARS DIFFERING IN MASS. Mihaila, I. M. (Univ. of Bucharest). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 154-9(1972).

Translated from Astron. Zh.; 49: No. 1, 197-203(1972).

A model is developed for a quasistationary spherical system of stars with different masses but an isotropic velocity distribution. The potential is assumed to be produced by stars of average mass, with stars of other masses comprising a small additional impurity. The density, centroid velocity, and velocity dispersion are determined for stars of different masses. The centroid velocity is directed toward the center; it increases with distance and decreases with mass. At each point in the system the velocity dispersion decreases with mass and approaches zero at the system boundary. (auth)

57034 ESTIMATE FOR THE FREQUENCY OF NOVAE IN THE ANDROMEDA NEBULA AND OUR GALAXY. Sharov, A. S. (Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.): 16: No. 1, 41-4(1972).

Translated from Astron. Zh.; 49: No. 1, 54-7(1972).

It is shown that 31 novae appear annually in the Andromeda Nebula. If the density distribution of the nova subsystems in the Andromeda Nebula and in the Galaxy is the same, the frequency of nova outbursts in the Galaxy would be about 260. This value may be construed as evidence that the Galaxy belongs to type Sb. (auth)

57035 SMALL NON-VELOCITY REDSHIFTS IN GALAXIES. Simkin, S. M. (Columbia Univ., New York). Nature (London); 239: No. 5366, 43-4(1 Sep 1972).

The question of whether or not the small excess redshifts observed in some companion galaxies have a nonvelocity origin has recently been raised; it has been pointed out that small, systematic errors in the redshifts of E and S0 galaxies might arise because the lines in the low-dispersion spectra on which they are measured do not have well-determined effective wavelengths. The data reported here support this possibility. In the three cases presented, systematic differences arise between velocities derived from measurements of CA II, H(λ3968.5), and K(λ3933.7) carried out "classically" (with a visually positioned, two coordinate measuring engine) and velocities derived from either "classical" measurements of other spectral lines in the same object or measurements of the same H and K lines using numerical techniques. (auth)

57036 RECOMBINATION LINE EMISSION FROM THE GALACTIC RIDGE. Davies, R. D.; Matthews, H. E.; Pedlar, A. (Univ. of Manchester, Eng.). Nature (London) Phys. Sci.; 238: No. 85, 101-3(14 Aug 1972).

An excess of ionized hydrogen is found to lie in the spiral structure between the sun and galactic center. Its electron temperature is 6,000 K, in contradiction to previous determinations. (auth) (UK)

57037 ROTATING SYSTEMS OF GRAVITATING BODIES IN THE QUASI-STATIONARY STATE. Agekyan, T. A.; Micheile, I. M. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 5: No. 4, 322-8(1969).

Translated from Astrofizika; 5: No. 4, 623-36(1969).

A set of equations describing the state and evolution of a rotating quasi-stationary system of gravitating bodies is derived. In contrast to previously obtained results, the theory is free of the assumption that the components of the residual velocity dispersion are equal. It is shown that there exists a rotating quasi-stationary system which evolves homologously and that the excess angular momentum carried off by dissipating stars and averaged over the system is equal to $^3/_2$ of the mean angular momentum of these stars. (auth)

57038 CENTRAL CONDENSATIONS IN Sa GALAXIES. Saakyan, K. A. (Byurakan Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 5: No. 4, 302-7(1969).

Translated from Astrofizika; 5: No. 4, 593-602(1969).

Results are reported of a classification of central condensations of 51 Sa galaxies. About 40% of the observed galaxies have stellar nuclei. Histograms are obtained for the central regions of the galaxies using the five-figure classification of the Byurakan Observatory together with photometric data for classes 5, 4, and 3. The results are compared with data of other workers. (auth)

57039 GALAXIES WITH ULTRAVIOLET CONTINUUM. III. Markaryan, B. E. (Byurakan Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 5: No. 4, 286-301(1969).

Translated from Astrofizika; 5: No. 4, 581-92(1969).

A list is presented of galaxies with an ultraviolet continuum containing data on 102 objects obtained as a result of an investigation of the spectra of weak galaxies. For 68 of these the presence of emission lines was detected or suspected. For 10 of these emission objects properties characteristic of Seyfert galaxies were established. Statistical treatment of the data in the three lists reported so far shows that, on the average, there is one galaxy which is brighter than 17m and has a strong ultraviolet continuum for every eight square degrees. Such galaxies, therefore, constitute approximately 2% of the total number of galaxies brighter than 17m. (auth)

57040 DISTRIBUTION OF GALAXIES IN THE CLUSTER ABELL 31. Bahcall, Neta A. (Princeton Univ., N. J.). Astron. J.; 77: No. 7, 550-6(Sep 1972).

The distribution of galaxies in the cluster Abell 31 (≡HMS 0025 + 2223; z = 0.16) is derived from galaxy counts on plates taken with the Palomar 48-inch Schmidt, the Mount Wilson 100-inch, and the Hale 200-inch telescopes. The distributions are given for two different limiting magnitudes; a total of 790 galaxies were counted in the photo-red magnitude range R ≃ 16.6 m to 19m. It is shown that the observed distributions of galaxies are in good quantitative agreement with the distribution appropriate to an Emden isothermal gas sphere. The derived structural length of the cluster is $\beta_{A\,31} = 0.45_{\text{min}} = 47$ kpc ($q_0 = 1$, $H_0 = 100$ km/sec Mpc). This value is in good agreement with the structural length of the Coma cluster, $\beta_{\text{Coma}} = 2_{\text{min}} = 37_{\text{kpc}}$ (Zwicky 1957), which has a redshift seven times smaller. The agreement between the two structural lengths supports the result obtained from evolving cosmologies that the angular sizes of clusters are proportional, in first approximation, to $(1 + z)^2/z$. The possibility that the bright galaxies are more centrally concentrated than the faint ones is studied; any effect larger than a factor of 2.5 in structural lengths is ruled out, but a smaller difference (about 80% in lengths) is suggested by the data. (auth)

57041 REINTERPRETATION OF ABELL'S COUNTS OF CLUSTERS. Rowan-Robinson, M. (Queen Mary Coll., London). Astron. J.; 77: No. 7, 543-9(Sep 1972).

A reexamination of Abell's counts of clusters indicates that they show the same evolutionary effect as quasars and radio galaxies. Possible interpretations in terms of the breakup of clusters, or of the extinction of galaxies, are discussed. (auth)

57042 OBSERVATIONS OF BRIGHT GALAXIES AT 80 MHz. Slee, O. B. (CSIRO, Sydney). Astrophys. Lett.; 12: No. 2, 75-9 (Oct 1972).

The 80-MHz radioheliograph with 3.7 arc min beamwidth was used to measure the flux densities, positions, and angular sizes of radio sources associated with 30 bright galaxies. The 80-MHz sources associated with 12 of the 24 galaxies detected had angular dimensions smaller than the optical diameters and were identified with nuclear or disk components. Radio brightness contours are presented for NGC 253 and used to separate the 80-MHz nuclear and disk sources. Separate spectra were constructed for the components. The nucleus is shown to possess a power-law spectrum with index $\alpha = -0.32$, while the disk spectrum is strongly curved and probably turns over between 80 and 408 MHz. (auth)

57043 PROTON SYNCHROTRON EMISSION AS AN EXPLANATION OF THE ELECTROMAGNETIC SPECTRUM OF THE GALACTIC CENTER. De Sabbata, V.; Fortini, P.; Gauldi, C. (Univ., Bologna). Astrophys. Lett.; 12: No. 2, 87-9(Oct 1972).

A model is proposed to explain the main features of γ, infrared, and radio emission from the galactic center, on the basis of hydrogen ionization in a very strong magnetic field and the resulting proton synchrotron radiation. (auth)

57044 IONIZATION STRUCTURE OF INTERSTELLAR CARBON. Weisheit, Jon C. (Univ. of California, Livermore); Dalgarno, A. Astrophys. Lett.; 12: No. 2, 103-6(Oct 1972).

The ionization equilibrium of interstellar carbon is determined for several model H I regions. The importance both of radiationless Auger transitions following K-shell ionizations of C I, C II, and C III and of ionizations by the measured isotropic x-ray background is established. The predicted carbon absorption-line strengths are significantly larger than earlier calculations had suggested. (auth)

57045 NEUTRAL-HYDROGEN STUDY OF THE COMPACT GALAXY II Zw 40. Gottesman, S. T. (Univ. of Florida, Gainesville); Weliachew, L. Astrophys. Lett.; 12: No. 2, 63-8(Oct 1972).

Interferometric observations at the 21-cm emission line of neutral hydrogen have yielded information on the dynamics and structure of the compact galaxy II Zw 40. The neutral hydrogen follows a core–halo distribution with characteristic Gaussian half-power widths of 52 arc sec and 350 arc sec. The bright optical object lies within the broader neutral H I core. The total neutral-hydrogen mass is 6.2×10^8 $M_\odot$ if the distance is 12.8 Mpc. The observed dynamics may imply rotation with a corresponding lower limit to the mass of 9.7×10^8 $M_\odot$ for a distance of 12.8 Mpc. The low metallicity and extremely blue color of this galaxy, coupled with its large H I dimensions, may imply that this object has only recently started to form stars within very restricted regions. (auth)

57046 OH IN THE HOFFMAN INFRARED SOURCES. Chaisson, Eric J.; Dickinson, Dale F. (Smithsonian Astrophysical Observatory, Cambridge, Mass.). Astrophys. Lett.; 12: No. 2, 119-22(Oct 1972).

OH was observed in the direction of two of the unidentified objects in the Hoffman 100-μm survey. In one case a Type IIb emission source was observed as well as a (probably unrelated) main-line absorption source. The other instance showed broadband absorption over a range of 100 km sec^{-1} and two narrow absorption sources. One (probably two) of the six objects identified as dark clouds showed normal main-line emission. (auth)

Cosmology

Refer also to abstracts 56961, 57345, 57412, 57446, 57460, and 57461.

57047 STABILITY OF AXISYMMETRIC SYSTEMS TO AXISYMMETRIC PERTURBATIONS IN GENERAL RELATIVITY. II. A CRITERION FOR THE ONSET OF INSTABILITY IN UNIFORMLY ROTATING CONFIGURATIONS AND THE FREQUENCY OF THE FUNDAMENTAL MODE IN CASE OF SLOW ROTATION. Chandrasekhar, S.; Friedman, John L. (Univ. of Chicago). Astrophys. J.; 176: No. 3, 745-68(15 Sep 1972).

The theory developed in Paper I is applied to solve two problems in general relativity: to obtain a criterion for the onset of instability in a uniformly rotating configuration via a neutral mode of axisymmetric oscillation; and to obtain an exact and an explicit formula for the square of the frequency of the fundamental axisymmetric mode of oscillation of a configuration rotating uniformly but slowly. (auth)

57048 THEORETICAL FRAMEWORKS FOR TESTING RELATIVISTIC GRAVITY. IV. A COMPENDIUM OF METRIC THEORIES OF GRAVITY AND THEIR POST-NEWTONIAN LIMITS. Ni, Wei-tou (California Inst. of Tech., Pasadena). Astrophys. J.; 176: No. 3, 769-96(15 Sep 1972).

Metric theories of gravity are compiled and classified according to the types of gravitational fields they contain, and the modes of interaction among those fields. The gravitation theories considered are classified as (i) general relativity, (ii) scalar–tensor theories, (iii) conformally flat theories, and (iv) stratified theories with conformally flat space slices. The post-Newtonian limit of each theory is constructed and its Parametrized Post–Newtonian (PPN) values are obtained by comparing it with Will's version of the formalism. Results obtained when combined with experimental data and with recent work by Nordtvedt and Will and by Ni, show that, of all theories thus far examined, the only currently viable ones are general relativity, the Bergmann–Wagoner scalar–tensor theory and its special cases (Nordtvedt; Brans–Dicke–Jordan), and a recent, new vector–tensor theory by Nordtvedt, Hellings, and Will. (auth)

57049 STABILITY OF HOMOGENEOUS UNIVERSES. Bonanos, Sotirios (Univ. of California, Santa Barbara). Commun. Math. Phys.; 26: No. 4, 259-70(1972).

The stability of a class of homogeneous cosmological models is investigated. It is shown that the perturbation problem for six such universes can be reduced to a system of ordinary differential equations. The time development of the perturbations is such that they remain finite at all times for which the unperturbed metric is nonsingular. (auth)

57050 DAMPING OF ADIABATIC PERTURBATIONS IN AN EXPANDING UNIVERSE. Chibisov, G. V. (Moscow Physical-

Technical Inst.). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 56-63(1972).

Translated from Astron. Zh.; 49: No. 1, 74-84(1972).

The damping of adiabatic density inhomogeneities by radiative viscosity and heat conductivity is examined, with allowance for the duration of the era of plasma recombination in an expanding universe. Adiabatic perturbations with masses up to $M \approx 10^{13}$ to 10^{14} $M_\odot$ would have been damped out. Nonlinear processes and the damping of density fluctuations and irrotational motions (by radiative viscosity) place an upper limit on the amplitude of the postrecombination density inhomogeneities which is much lower than the presumed value in the classical model of galaxy formation from adiabatic irregularities; that model is therefore in difficulty. Secondary heating of the plasma would only strengthen the damping. In particular, in fully ionized plasma ($z \approxeq 10^3$) adiabatic perturbations would be damped up to a mass $M \approx 10^{18}$ $M_\odot$. (auth)

57051 THREE-BODY PROBLEM WITH NONSTATIONARY NEWTON-HOOKE INTERACTION, AND ITS APPLICATION TO MOTIONS IN THE UNIVERSE. Omarov, T. B. (Astrophysical Inst., Alma-Ata, USSR). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 149-53(1972).

Translated from Astron. Zh.; 49: No. 1, 191-6(1972).

A solution in quadratures is obtained for a generalized formulation of the celestial-mechanics problem of two bodies, including a background of uniformly distributed and isotropically expanding gravitating matter in an Einstein–de Sitter universe. Apart from their independent significance, the results are of interest from the standpoint of the role of the metagalactic "cooling rate" in a possible regular perturbation of the gravitational field in a homogeneous and isotropic model universe (large-scale inhomogeneity). These results imply that even if the assumptions of homogeneity and isotropy are justified to high accuracy in some region of the universal substratum, the applicability of the corresponding standard expression for the law of peculiar-velocity variation would be restricted by the extremely stringent requirement that the model universe be globally homogeneous. (auth)

57052 ROBERTSON-WALKER COSMOLOGY AND FRIEDMANN COSMOLOGY. Heller, Michal. Postepy Astron.; 20: No. 3, 241-50(1972). (In Polish).

A differentiation between the Robertson–Walker and Friedmann cosmologies is introduced based on arguments pertaining both to the essence as well as to the history of the problem. By the Robertson–Walker cosmological model one understands any space–time continuum that can be unfolded into a universal cosmic time and 3-dimensional spaces t = const orthogonal to the timelines, supplemented with some additional conditions as to the motion of particles and photons. One includes into the Friedmann cosmology those of the Robertson–Walker models that represent solutions of the gravitational field equations of general relativity. A classification of the R–W cosmological models is given, according to the possible isometry groups. This classification includes as special cases: Milne's cosmology (relativistic kinetics) and the cosmology by Bondi–Gold and Hoyle (steady-state). Models representing solutions of the field equations in general relativity and possessing symmetries connected with the isometry groups of less than 6 parameters are called non-Friedmannian. (auth)

57053 GENERALIZED RELATIVISTIC THEORY OF GRAVITATION. II. BARYON CONFIGURATIONS. Saakyan, G. S.; Mnatsakanyan, M. A. (Erevan State Univ.). Astrophysics (Engl. Transl.); 5: No. 4, 271-85(1969).

Translated from Astrofizika; 5: No. 4, 555-79(1969).

Further transformations are reported of the field equations of the generalized relativistic theory of gravitation for the interiors of static spherically symmetric mass distributions. Limiting transition to the equations of the general theory of relativity and the correspondence principle are discussed. Conditions on the surface and at the center are considered for which the configuration can have finite central pressure. A detailed description is given of the integration process for the interior boundary-value problem. Certain important properties of gravitars, characterized by the condition $M/R \gg 1$, are derived. Results of a numerical integration for an incompressible fluid and a real baryon gas are compared with the corresponding results predicted by other theories. Gravitars are models of supermassive static formations with definite values of P_0/ρ_0 and anomalously large gravitational mass defects. (auth)

57054 COSMOLOGIC SOLUTIONS OF THE JORDAN-DICKE FIELD EQUATIONS AND OBSERVATIONAL DATA. Mandzhos, A. V. (Kiev State Univ.). Astrophysics (Engl. Transl.); 5: No. 4, 334-6(1969).

Translated from Astrofizika; 5: No. 4, 649-53(1969).

The tensor-scalar theory of Jordan and Dicke, which is not inconsistent with existing observational data, has been developed in parallel with the Einstein equations for the gravitational field. In addition to the metric tensor the Jordan–Wicke theory introduces a variable scalar which is present in the Einstein field equations in the form of the gravitational constant. The idea of a variable "gravitational constant" is consistent with many largely geophysical data. Some cosmological consequences of the Jordan–Dicke equations are reported. (W.D.M.)

57055 FARADAY ROTATION IN THE BRANS-DICKE COSMOLOGY. Burman, R. (Univ. of Western Australia, Nedlands). Lett. Nuovo Cim.; 4: No. 13, 643-4(29 Jul 1972).

Faraday rotation by a cosmic magnetic field is calculated for the spatially flat form of the Brans–Dicke cosmology. (J.W.R.)

57056 ELECTROMAGNETIC DISPERSION IN THE BRANS-DICKE COSMOLOGY. Burman, R. (Univ. of Western Australia, Nedlands). Lett. Nuovo Cim.; 4: No. 13, 645-6(29 Jul 1972).

The dispersion of an electromagnetic wave in an ionized cosmic medium is calculated for the spatially flat form of the Brans–Dicke cosmology. The results are compared with calculations for the steady-state universe. (J.W.R.)

57057 KINETIC THEORY OF NEUTRINOS IN ANISOTROPIC COSMOLOGICAL MODELS. Droshkevich, A. G.; Zel'dovich, Ya. B.; Novikov, I. D. (Inst. of Applied Mathematics, Moscow). Astrophysics (Engl. Transl.); 5: No. 4, 264-70(1969).

Translated from Astrofizika; 5: No. 4, 539-53(1969).

The role of neutrinos and other weakly interacting particles in anisotropic cosmologic models is discussed. The kinetic-theory method is used to show that, when realistic properties are assumed for them, the neutrinos become free during the anisotropic stage of the expansion so long as the anisotropy is still large. Thereafter all the processes proceed as described by Doroshkevich, et al. (1967). (auth)

57058 PROPAGATION OF RADIATIVE SHOCK WAVES IN AN INHOMOGENEOUS COSMIC MEDIUM. Chow, T. L. (California State Coll., Turlock). J. Phys., A (London); 5: No. 9, 1409-18(Sep 1972).

The propagation of two strong radiative shocks moving opposite in an inhomogeneous cosmic medium is calculated by using a "modified" characteristic method. It is found that the shock propagation is seriously affected by radiation losses and by the inhomogeneity of the medium; the cooled and recombined post-shock gas first appears near the shock front. This differs from results derived from steady state solutions, which predict that the condensation should appear first at the contact surface. (auth) (UK)

57059 SPHERICAL GRAVITATIONAL COLLAPSE WITH ESCAPING NEUTRINOS. Krishna Rao, J. (King's Coll., London). J. Phys., A (London); 5: No. 4, 479-88(Apr 1972).

The general relativity equations for the dynamics of spherically symmetric perfect fluid distributions with an outward neutrino flux are studied. The geometrical part of the field equations is simplified by introducing the eigenvalue of the Weyl tensor in the 2-2 component of the Einstein tensor. It is pointed out that the presence of a free gravitational field produces shearing forces inside the material sphere. An energy equation which shows clearly how the total (fluid and radiation) pressure does work in a material sphere across its moving boundary is obtained. (auth) (UK)

57060 SURFACE-OF-REVOLUTION COSMOLOGY. Ryan, Michael P. Jr. (Landau Inst. of Theoretical Physics, Moscow). Ann. Phys. (N. Y.); 72: No. 2, 584-604(Aug 1972).

A cosmological model for which the three-geometry at any one time is represented by a three-dimensional surface of revolution is presented. For this model the Einstein equations and their numerical solution are discussed. A limit near the Friedmann k = +1 cosmology and another limit in which the universe evolves into two symmetrical halves connected at a point where the curvature invariants become singular are discussed. How the model can be connected to the real universe by observations is considered. A brief discussion of quantization and the region of superspace inhabited by the model is given. (auth)

Planetary Phenomena

Refer also to abstract 57444.

57061 (CONF-720121-1) TRAPPED SOLAR WIND NOBLE GASES IN APOLLO 12 LUNAR FINES 12001 AND APOLLO 11 BRECCIA 10046. Eberhardt, P.; Geiss, J.; Graf, H.; Groegler, N.; Mendia, M. D.; Moergeli, M.; Schwaller, H.; Stettler, A.;

Kraehenbuehl, U.; von Gunten, H. R. (Bern Univ. (Switzerland)). Feb 1972. 91p. Dep. NTIS (U. S. Sales Only).

From third lunar science conference; Houston, TX. (10 Jan 1972).

The concentrations and isotopic composition of the five noble gases were measured in an unseparated bulk sample of the Apollo 12 fines 12001, in seven bulk and five ilmenite grain size fractions from 12001 and in four ilmenite grain size fractions separated from the Apollo 11 breccia 10046. In addition, Sr, Zr, Ba, La, Ce, Sm, and Eu were determined in several bulk grain size fractions from 12001. (auth)

57062 MEASUREMENTS OF RADON EMANATION FROM APOLLO 11, 12, AND 14 FINES. Yaniv, A.; Heymann, D. (Rice Univ., Houston, Tex.). Earth Planet. Sci. Lett.; 15: No. 2, 95-100(Jun 1972).

Less than 0.13% of all ^{222}Rn atoms produced in Apollo 11 fines 10084 emanate from this material at temperatures ranging from about 25 to 35°C and a pressure of about 10^{-2} torr. The value for Apollo 12 fines 12007 is <0.73% or <0.57%, depending on the adopted U content. For the combined Apollo 14 fines 14003 + 14259 a minimum value of 0.23%, and a maximum value of 0.55% were found. Emanation of ^{220}Rn was observed in the case of the Apollo 14 fines. The relatively small emanation rates could be due to the absence of interstitial air and water on the lunar surface as has been suggested by Lindstrom et al. (1971). However, it seems also possible that U and Th are principally contained in the lunar fines within minerals which are intrinsically poor radon emanators, such as zircons. The small emanation rates require 100% ^{222}Rn escape from a regolith thickness of about 10 m (U ~ 4 ppm) to explain the observed ^{210}Po activity in Mare Tranquillitatis by Turkevich et al. (1970). However, this problem cannot be settled satisfactorily until emanation measurements have been made at temperatures of about 120°C. (auth)

57063 LUNAR NEUTRON STRATIGRAPHY. Russ III, G. Price; Burnett, D. S.; Wasserburg, G. J. (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 15: No. 2, 172-86(Jun 1972).

Variations in the isotopic ratios ^{158}Gd/^{157}Gd and ^{150}Sm/^{149}Sm in the Apollo 15 deep drill stem show that the neutron fluence is a smoothly varying function of depth with a relatively symmetric peak at a depth of 190 g/cm^2. The peak fluence is about 60% greater than the surface value. The observed peak is at a depth comparable to the theoretically calculated peak in the neutron flux. These data may be quantitatively explained by a model in which a blanket of pre-irradiated material was deposited rapidly 450×10^6 yr ago which has remained essentially undisturbed since, i.e., the material was deposited during terrestrial Cambro—Ordovician time. The upper several cm of the drill stem represents soil which has been mixed and transported to the drill site by shallow impacts. Other models quantitatively compatible with the data are those for a regolith continuously accreting for a time as long as 400×10^6 yr and subsequently irradiated for $\sim 500 \times 10^6$ yr as an unmixed section. This would allow the base of the drill stem to be as old as 900×10^6 yr. These results show that at this site the turnover time to 2.5 m depth is significantly greater than about 500 my. No positive evidence of ray material from Aristillus or Autolycus was observed in the fluence data. Studies of a variety of cosmic-ray nuclei from deep cores from several sites should permit the determination of detailed depositional histories. If deeper core samples could be obtained, it should be possible to study over a billion years of lunar stratigraphy. However, the determination of absolute stratigraphic ages will require that neutron capture rates be determined in situ by accurate methods. (auth)

57064 LAW OF PLANETARY DISTANCES. Polyachenko, V. L.; Fridman, A. M. (Novosibirsk State Univ., USSR). Sov. Astron. AJ (Engl. Transl.); 16: No. 1, 123-8(1972).

Translated from Astron. Zh.; 49: No. 1, 157-64(1972).

The stability of the protoplanetary-cloud model for the solar system as a flat disk of gas and dust was investigated. An initial profile was obtained for the surface density of the disk such that growing axisymmetric density perturbations will occupy the sites of the planetary orbits. The surface density would have declined $\approx 1/r^2$ for $r < 14$ A.U. and $\approx 1/r^3$ beyond. A criterion was derived for gravitational stability of the gas—dust disk, indicating that the planets today comprise no more than 3% of the mass of the protoplanetary cloud. Possible mass-loss mechanisms are discussed. (auth)

57065 ^{222}Rn IN THE LUNAR ATMOSPHERE. Brodzinski, R. L. (Battelle-Northwest, Richland, Wash.). Nature (London) Phys. Sci.; 238: No. 85, 107-9(14 Aug 1972).

Previous estimates of ^{222}Rn concentrations in the lunar atmosphere are reviewed; these showed considerable discrepancies. In an effort to resolve some of these discrepancies pieces of solar wind foil exposed on the Moon by Apollo astronauts were analyzed for their ^{210}Po content, using a very sensitive method. From the net ^{210}Po concentration in an Apollo 12 foil on equilibrium lunar ^{222}Rn activity of 0.082 ± 0.012 d/cm^2/S was obtained for Oceanus Proceblurum. This lunar atmospheric concentration is equivalent to the total radon generated by about 7 cm. of lunar soil and would support an equilibrium ^{210}Po surface activity of 0.0238 ± 0.0035 a/cm^2/S. The outer reflective coating of the spacecraft should also act as a collector of radon daughters escaping from the Moon, and small pieces were similarly analyzed for ^{210}Po; exposures to the surface of the Moon were, however, uncertain, rendering results unreliable. It is considered that the effects of the lunar vacuum and the widely varying surface temperatures are probably most responsible for the distribution of radon on the Moon's surface. The concentration at any given location is probably most affected by the temperature and time of the lunar day. (UK)

57066 DETECTION OF MOLECULAR OXYGEN ON MARS. Carleton, N. P.; Traub, W. A. (Harvard Univ., Cambridge, Mass.). Science; 177: No. 4053, 988-92(15 Sep 1972).

Molecular oxygen was detected in martian spectra near 7635 angstroms and its abundance measured both during and after the 1971 dust storm. Its column abundance in the clear martian atmosphere is about 10.4 ± 1.0 centimeters amagat, giving a mixing ratio of molecular oxygen to carbon dioxide of 1.3×10^{-3}. The mixing ratio of molecular oxygen to carbon monoxide (1.4 ± 0.3) is quite different from the value of 0.5 that would result from the photolysis of a pure carbon dioxide atmosphere, which indicates that there is or was a net source of oxygen relative to carbon (probably water) in the martian atmosphere. (auth)

57067 MOESSBAUER SPECTROSCOPY OF IRON DISTRIBUTION IN MINERALOGICAL FRACTIONS SEPARATED FROM LUNAR ROCKS COLLECTED BY APOLLO 12. Duchesne, J.; Depireux, J.; Gerard, A.; (and others). Bull. Cl. Sci., Acad. Roy. Belg.; 57: No. 11, 1204-11(1971). (In French).

A detailed study has been made by Moessbauer spectroscopy on mineralogical fractions isolated from some Apollo 12 rocks. The resolution enhancement brought about by the mineralogical enrichment of the various fractions allows a better estimate of distribution of Fe^{++} ions between the different mineral phases. (auth)

57068 HIGH TEMPERATURE PROTOPLANETARY PROCESSES (ON THE PROBLEM OF FORMATION OF METALLIC CORES OF PLANETS). Vinogradov, A. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geochem. Int. (Engl. Transl.); 8: No. 6, 799-812(1971).

Translated from Geokhimiya; No. 11, 1283-96(1971).

The problem of formation of metallic cores of planets is discussed, and it is shown that of all the existing hypotheses, the hypothesis of condensational growth of the iron—nickel cores from cooling plasma cloud of solar composition is the best documented. It is demonstrated that the distribution of the elements between the condensing phases (iron and silicate) is controlled by the partial pressure of oxygen in the system Fe—O. (auth)

57069 RELATION BETWEEN JUPITER'S DECAMETRIC RADIO EMISSION AND ITS GREAT RED SPOT. Basu, D.; Pires, J. L. (Univ., Mackenzie, Sao Paulo, Brazil). Astrophys. Lett.; 12: No. 2, 99-100(Oct 1972).

Good correlation was found between the visibility of Jupiter's Great Red Spot and the Jovian decameter radiation at 18.0, 22.2, and 27.6 MHz. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 57120, 57175, 57853, and 57867.

57070 IONOSPHERIC SUBSTORMS. Driatsky, V. M.; Shumilov, O. I. (Arctic and Antartic Scientific Research Inst., Leningrad). Planet. Space Sci.; 20: No. 9, 1375-89(Sep 1972).

Ionospheric substorms are considered in terms of the development of the auroral absorption substorm using riometer data. This type of ionospheric disturbance is caused by the injection of energetic particles from the magnetosphere—often electrons of from 10 to 100 or 200 keV. It is shown that the initial injection begins near local midnight for latitudes L of about 5 to 6°, from where the anomalous absorption region spreads in all directions. The western movement is observed between 14 and 22 hr LT. Its speed is 1 to 3°/min. The boundary of the southern and northern movements is located at L near 5 to 7°. The average speed of the southerly and northerly movements appeared to be 0.2 to 0.4°/min. Consideration is given to all models proposed to explain the observed dynamical AA changes during the auroral substorms in terms of the magnetospheric dynamical processes, that is: (1) the drifting model, (2) the Hargreaves model (propagation of some hydromagnetic disturbance in the magnetosphere) and (3) the widening oval model. It is shown that most of the experimental data (direct and indirect) can be treated on the basis of model (1). (auth)

57071 ELECTRON RESONANCES OBSERVED WITH TOPSIDE SOUNDERS. Muldrew, D. B. (Communications Research Centre, Ottawa). Radio Sci.; 7: No. 8-9, 779-89(1972).

Ionograms recorded with ionospheric sounders aboard rockets and satellites show signals (resonances) that can persist from a fraction of a millisecond to many milliseconds after the termination of the transmitted pulse. Many of the characteristics of the resonances at the plasma frequency f_N, the upper-hybrid frequency f_T, the harmonic gyrofrequencies nf_B, where $n \geq 2$, and the maximum frequencies of the Bernstein modes f_{Qn} can be explained by propagating electrostatic waves. At frequencies near f_N, f_T, and nf_B, electrostatic waves of slightly different frequencies generated by the transmitted pulse propagate in the ionospheric plasma, become reflected at distances up to several hundred meters away from the satellite, and return to the satellite, producing a continuous receiver response following the transmitted pulse. The resonance observed at the gyrofrequency f_B is not yet understood. Nonlinear properties of the receiving system and/or the plasma can result in resonances observed at the sum and difference frequencies of the principal resonances. Other resonance phenomena are also discussed. (54 references) (auth)

57072 PRECONDITIONS FOR THE TRIGGERING OF POLAR MAGNETIC SUBSTORMS BY STORM SUDDEN COMMENCEMENTS. Burch, J. L. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res.; 77: No. 28, 5029-32(1 Oct 1972).

The possible relationship between the latitude of the interplanetary magnetic field (IMF) for a period before storm sudden commencements and the probability of ssc-triggered negative bays was examined. It was found that from a study of 36 ssc for which IMF data are available, 10 ssc produced simultaneous negative bays and that 9 of the 10 ssc were preceded by a period of southward IMF. The tenth was associated with a period of high interplanetary magnetic-field strength. The study for the period June 1965 to January 1967 indicates that sufficient conditions for the triggering of simultaneous polar magnetic substorm onsets were: (1) an ssc amplitude of $>10\ \gamma$ and (2) an average geocentric solar magnetospheric (GSM) Z component of interplanetary magnetic field of less than $-1\ \gamma$ over a period of at least ½ hour preceding the ssc. The one ssc that was not preceded by a period of southward IMF also triggered a simultaneous negative bay, and was associated with a nearly horizontal IMF of magnitude higher than that of any other event not satisfying the conditions. Detailed consideration of this event indicates that enhanced auroral-zone magnetic activity typical of the substorm growth phase preceded the ssc and that magnetospheric conditions were similar to those expected for southward IMF of lower magnitudes. Conclusions are made by the authors in agreement and contrary to work previously published by several authors. (J.C.W.)

57073 EQUATORIAL SPREAD F: RECENT OBSERVATIONS AND A NEW INTERPRETATION. Balsley, B. B. (National Oceanic and Atmospheric Administration, Boulder, Colo.); Haerendel, Gerhard; Greenwald, R. A. J. Geophys. Res.; 77: No. 28, 5625-8(1 Oct 1972).

Equatorial spread F was classified previously as weak or strong according to the relative echo strength at 50 MHz. Data were obtained at Jicamarca Radar Observatory and showed that no existing theory of spread F could adequately account for all of the observed characteristics, (Farley et al., J. Geophy. Res., 75: 7199(1970)). The data included spectra of weak spread F echoes only. Spectral observations are presented now for strong spread F echoes obtained at the Thumba Equatorial Rocket Launch Station during March 2–5, 1972, and limited to strong spread F. A general outline of a new theory is given that qualitatively agrees with the observations. A comparison was made between the narrow spectral components observed at Thumba and the weak spread F reported by Farley et al. (J.C.W.)

57074 RADAR OBSERVATIONS OF EQUATORIAL SPREAD F IN A REGION OF ELECTROSTATIC TURBULENCE. McClure, J. P. (Univ. of Texas, Dallas); Woodman, R. F. J. Geophys. Res.; 77: No. 28, 5617-21(1 Oct 1972).

Radar observations of a well-developed layer of strong equatorial spread F are presented. The scattering cross section, correlation lifetime, and vertical electromagnetic drift velocity of the spread-F irregularities were measured as a function of altitude and time with resolutions of 10 km and 1 min, respectively. The vertical drift velocities were often $\gtrsim 100$ m/sec,, which is greater by a factor of 3 to 4 times than the vertical drift velocity of the normal undisturbed equatorial ionosphere at similar times. Also the velocity pattern exhibited a turbulent structure, changing sign irregularly every few tens of km and every few minutes, on the average. This observation confirms a recent satellite implication that, based on similarities in their statistical occurrence patterns, electrostatic turbulence and spread F are related. Finally, the finding that the correlation lifetimes of the 3-meter irregularities responsible for radar backscatter vary inversely with the scattering cross section confirms and extends earlier radar results. (auth)

57075 QUADRUPLE CONJUGATE PAIR OBSERVATIONS OF THE SUDDEN COMMENCEMENT ABSORPTION EVENT ON JUNE 17, 1965. Brown, R. R. (Univ. of California, Berkeley); Leinbach, H.; Akasofu, S.-I.; (and others). J. Geophys. Res.; 77: No. 28, 5602-7(1 Oct 1972).

Sudden commencement absorption at 2144 UT, June 17, 1965, was observed with two groups of conjugate riometers separated by approximately 100° in magnetic longitude. The location of the region of maximum precipitation occurred in the local afternoon hours. From closely spaced riometers in the midnight sector, evidence is presented indicating that the triggering of magnetospheric substorms by sudden commencements is highly structured. (auth)

57076 DIURNAL VARIATION OF THE CORRELATION OF Pc 3 AND Pc 4 MICROPULSATION CHARACTERISTICS WITH MAGNETIC ACTIVITY. Stening, R. J. (Univ. of the West Indies, Kingston, Jamaica); Gupta, J. C. J. Geophys. Res.; 77: No. 28, 5590-6(1 Oct 1972).

Thirty-four days of micropulsation data (July 12 to August 16, 1968) taken simultaneously at four observatories in Canada have been analyzed for Pc-3 and Pc-4 occurrence. The correlations of Pc occurrence with Kp and AE indices have been evaluated at different local times, and a significant diurnal variation in the correlation is found. The daytime occurrence correlation with Kp is much lower than the nighttime correlation at Ottawa and Meanook. At these stations an increase in correlation is found when daytime Pc-3 occurrence is correlated with Kp values found 6 to 12 hours earlier. A negative correlation of Pc-4 occurrence with Kp is found during some hours at Ottawa. A comparison has been made of the correlation of Pc amplitude with Kp. The relevance of the results to theories of generation and transmission of micropulsations is discussed. (auth)

57077 ELECTRON POLAR CAP AND THE BOUNDARY OF OPEN GEOMAGNETIC FIELD LINES. Evans, L. C.; Stone, E. C. (California Inst. of Tech., Pasadena). J. Geophys. Res.; 77: No. 28, 5580-4(1 Oct 1972).

A total of 333 observations of the boundary of the polar-access region for electrons ($E_e > 530$ keV) provides a comprehensive map of the electron polar cap. The boundary of the electron polar cap, which should occur at the latitude separating open and closed field lines, is consistent with previously reported closed field line limits determined from trapped-particle data. The boundary, which is sharply defined, seems to occur at one of three discrete latitudes. Although the electron flux is generally uniform across the polar cap, a limited region of reduced access is observed about 10% of the time. (auth)

57078 CROSSOVER FREQUENCIES IN MULTICOMPONENT PLASMAS WITH NEGATIVE IONS. Das, G. C.; Uberoi, C. (Indian Inst. of Science, Bangalore). J. Geophys. Res.; 77: No. 28, 5597-5601(1 Oct 1972).

A simple model of plasma with two positive and one negative ionic species is used to study the effect of negative ions on the crossover frequencies in a multicomponent plasma. Both qualitative and quantitative results show very interesting features of the existence and behavior of crossover frequencies, especially when the negative ion mass has a value intermediate to the values of the two positive ion masses. (auth)

57079 ROCKET OBSERVATION OF TOPSIDE RESONANCES. McAfee, J. R.; Thompson, T. L.; Calvert, W.; Warnock, J. M. (National Oceanic and Atmospheric administration, Boulder, Colo.). J. Geophys. Res.; 77: No. 28, 5542-50(1 Oct 1972).

In a recent rocket experiment designed to resolve the slow-valve echoes comprising the resonances excited by topside sounders the plasma, the upper hybrid resonance, and the first three electron cyclotron resonances were observed. In particular, the variation of echo frequency versus delay was observed for the upper hybrid resonance. The good agreement found between the observed and the predicted frequency delay function confirms the slow-wave propagation nature of the phenomenon. The frequency of all three electron cyclotron resonances are consistent with the Pogo (3/68) magnetic-field model within its stated accuracy. (24 references) (auth)

57080 SOURCE AND IDENTIFICATION OF HEAVY IONS IN THE EQUATORIAL F LAYER. Hanson, W. B. (Univ. of Texas, Dallas); Sterling, D. L.; Woodman, R. F. J. Geophys. Res.; 77: No. 28, 5530-41(1 Oct 1972).

Further evidence is presented to show that the interpretation of some Ogo-6 retarding potential analyzer (RPA) results in terms of ambient Fe$^+$ ions is correct. The Fe$^+$ ions are observed only within dip latitudes of ±30°, and the reason for this latitudinal specificity is discussed in terms of a low-altitude source region and F-region diffusion and electrodynamic drift. It is shown that the polarization field associated with the equatorial electrojet will raise ions to 160 km out of a chemical source region below 100 km but it will do so only in a narrow region centered on the dip equator. Subsequent vertical $E \times B$ drift, coupled with motions along the magnetic fields, can move the ions to greater heights and greater latitudes. There should be a resultant fountain of metallic ions rising near the equator that subsequently descends back to the E and D layers at tropical latitudes. Even if the metallic ions do have access to the lower F region at higher latitudes, the downward plasma flow at the F peak will restrict their access to the upper F region. (auth)

57081 ROCKET MEASUREMENTS OF ELECTRON INFLUX DURING A MAJOR MAGNETIC STORM WITH TYPE-A AURORA. McEwen, D. J.; Sivjee, G. G. (Univ. of Saskatchewan, Saskatoon). J. Geophys. Res.; 77: No. 28, 5523-9(1 Oct 1972).

A Black Brant 5 rocket was flown during a Type-A aurora from Fort Churchill on August 17, 1970, carrying an electron spectrometer that recorded the spectrum from 20 eV to 18 keV up to an apogee of 268 km throughout the flight. A major magnetic storm was in progress, and the I_{6300}/I_{5577} ratio measured on the ground was as high as 4 with a 6300-A brightness of 14 kR. A greatly enhanced low-energy electron flux was observed with a shape in the energy range 0.1 to 1 keV similar to that of a Maxwellian distribution with characteristic energy of about 300 eV. Details of the electron spectra and the related measurements are presented. (auth)

57082 DEPENDENCES BETWEEN COURSE OF SOLAR ACTIVITY AND PROCESSES IN SUN–EARTH SPACE. Velinov, P. I. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 3, 321-4(1972).

The dependence between the annual course of solar activity and the ionosphere and other processes were previously investigated (Compt. Rend. Acad. Bulg. Sci., 25: 189(1972)); these included only the geomagnetic index of solar radio bursts of type IV and of the index dealing with disturbances in 164-kHz radio waves due to rapid changes against the background of hard x radiation. Now, new processes have been advanced and the processes examined here include galactic cosmic rays, comets, ionosphere, geomagnetic field, noctilucent clouds, aurora, velocity of Earth rotation, earthquakes, movements of poles, and deep earthquakes. The spatial dependence of frequencies of the solar effects during the 11-year cycle on the processes is given. Also the dependences between monthly and daily courses of solar activity on the processes are discussed. (J.C.W.)

57083 SOURCE OF SUNRISE EFFECTS IN THE LOW IONOSPHERE. Nestorov, G. T.; Apostolov, E. M. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 3, 313-16 (1972).

The path of a 164-kHz frequency signal from Allouis to Sofia, a distance of 1,720 km, was studied for sunrise effects and interference was observed at certain periods, especially in the spring. Interference is chiefly between the ionospheric wave and the ground wave, between two ionospheric waves once-reflected on different levels, and between once- and twice-reflected ionospheric waves. On paths where the ground wave cannot be neglected, the mechanism of interference between the ground and ionospheric waves is real. An examination is made here, in the case of paths where the ground wave is negligible, to determine whether interference or intensity phenomena prevail. Some authors assume that this is due to temporary variations of the amplitude of a once-reflected ionospheric wave. Here, it is concluded that structural changes in electron density in time may lead to intensity changes that have the character of an interference picture in the sunrise period. (J.C.W.)

57084 IONOSPHERIC D REGION: A SENSITIVE DETECTOR OF HARD X RAYS OF SOLAR SUBFLARES. Nestorov, G. T. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 3, 317-20(1972).

In December 1970, 117 SID's were recorded at Sofia and 54 were of weak intensity identified as subflares. The recordings were made on long, medium, and short waves at ionospheric D-region heights. Relations are discussed between subflare SID's and x-ray flux below 3 Å; between subflare SID's and an x-ray flux below 8 Å; between subflare SID's and solar radio emission; and between number of SID's and number of subflares observed in the Hα line. The analysis shows: the ionospheric reaction of subflares accompanied by x ray is most manifest on medium waves; second in sensitivity are SID's on long waves, when the spatial wave considerably exceeds the amplitude of the ground wave; and in third place, absorption on short wave. (J.C.W.)

57085 VARIATION WITH ELECTRON VELOCITY POWERS OF ELECTRON COLLISION FREQUENCY AND ENERGY TRANSPORT COEFFICIENTS IN WEAKLY IONISED PLASMAS: EARTH'S LOWER IONOSPHERE. Sharma, V. N. (Univ., Banaras Hindu, India). Int. J. Electron.; 33: No. 4, 447-56 (Oct 1972).

Height profiles were calculated for various electron-energy-transport coefficients such as diffusion coefficient, electrical conductivity, and thermal conductivity. Correction factors were applied, taking into account the variation of the electron—neutral collision frequency with different powers of electron velocity. Results are discussed in the light of simple gas kinetic model rules which were shown to break down in the presence of central interaction between electron and neutrals (i.e., in the Earth's lower ionosphere). Also, assuming the electron energy transport due only to a difference in electron and neutral gas temperatures, height profiles for effective heat flux were obtained corresponding to different values of ∇T_e. These profiles, on comparison with one another and also with the height profile for the ionospheric G factor, show clearly no transport of electron energy in the Earth's lower ionosphere due to thermal conduction. (auth)

57086 STRUCTURE OF THE E_S LAYER ACCORDING TO SPACED SOUNDINGS. Ovezgel'dyev, O.; Vasil'ev, K. N.; Mikhailova, G. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 110-12(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 131-3(1972).

The results of 32 observations were analyzed of space–time variations of the frequency parameters of the E_S layer from soundings at three points with a base L < 100 km. A comparison of the curves of temporal variations of the limiting reflection frequency, f_oE_S, and of the blanketing frequency, f_bE_S, at the three points shows that they are identical. Usually the maxima and minima of the frequency parameters are shifted in time, which indicates a horizontal movement of sporadic formations. The frequency parameters and the electron density in the layer are inhomogeneous in the horizontal plane. Horizontal inhomogeneities were estimated from differences in frequency parameters at the spaced points and histograms constructed of their distribution for individual observations. Relative fluctuations of the frequency parameters were described. Auto- and cross-correlation functions of the frequency parameters of the E_S layer for 27 observations were computed. The rate of movement of sporadic formations is determined and the most probable direction of motion is given. The dimensions of the ionization clouds forming the layer are estimated. (J.C.W.)

57087 KINETIC INSTABILITY OF A CONFINED ELECTRON BEAM IN A PLASMA. Dolan, I. D. (Inst. of Nuclear Physics, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 14-19(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 18-23(1972).

The instability of a confined electron beam in a plasma in a strong magnetic field is analyzed in the kinetic approximation. The instability increments are found for a cylindrical and a plane beam. (auth)

57088 MEASUREMENT OF THE TEMPERATURE OF THE NEUTRAL ATMOSPHERE WITH THE RIM-901 INSTRUMENT ON COSMOS 320. Dzhordzhio, N. V.; Nikolaenko, E. M.; Ol'dekop, L. G.; Khavin, E. E. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 66-9(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 77-82(1972).

The RIM-901 instrument for measuring the temperature of the neutral atmosphere is described and the results of measurements are reported. Neutral temperature fluctuations, similar to those observed earlier in ion temperature, were discovered in the evening near the equator. (auth)

57089 PROPAGATION OF A HYDROMAGNETIC PULSE IN AN IONOSPHERIC WAVEGUIDE. Gorbachev, L. P.; Savchenko, Yu. N. (Moscow Engineering-Physics Inst.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 60-5(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 71-6(1972).

A multiple-layer plasma waveguide in a constant, homogeneous magnetic field, simulating an ionospheric waveguide, is analyzed. The method of normal waves is used to study the propagation of a hydromagnetic pulse of arbitrary shape. Relationships are obtained for pulses of electric intensity and of disturbed magnetic field induction. The results are reported of numerical computations of the phase and group velocities of the second normal wave and also of the derivative of the axial component of the pulse of magnetic field induction. (auth)

57090 CONFIGURATION OF REGIONS RESPONSIBLE FOR THE AURORAL SCATTERING OF VHF SIGNALS. Uspenskii, M. V.; Sverdlov, Yu. L.; Miroshnikov, Yu. G. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 57-9(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 68-70(1972).

Some results of investigations of auroral backscatter at λ = 3.4 m are reported. A two-lobe horizontal interferometer is used to increase the angular resolution of the radar station. The various locations of the scattering regions are described. The measured angular spectrum of scattering for a signal pulse volume 1.2 km long varies from 0.5 to 8°. The possible characteristics of inhomogeneities responsible for scattering are examined. (auth)

57091 AVERAGE ELECTRON DENSITY PROFILES OF THE D LAYER AND THEIR DEPENDENCE ON THE SOLAR ZENITH ANGLE. Zinger, V.; Bremer, I. (Ionospheric Observatory, Kuehlungsborn, Ger.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 45-9(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 54-9(1972).

The average profiles are computed for solar zenith angles of 40, 60, 70, and 80° in summer and at low solar activity from the data found in the literature on electron density profiles of the D region. The profiles obtained agree well with experimentally determined parameters, computed from data on the propagation of long radio waves. (auth)

57092 EXPONENTIAL MODEL OF THE IONOSPHERIC D REGION. Nestorov, G. (Inst. of Geophysics, Sofia). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 36-44(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 44-53(1972).

It is suggested that the N(h) profile be approximated by two exponential functions: the first describes the effect of cosmic rays and does not vary significantly in the course of a day and the second allows for the action of solar x rays and L_α radiation and depends on the solar zenith angle. The approximation introduced makes it possible to associate measured absorption with the physical D-region parameters. This model also permits finding the variation of the N(h) profile during solar chromospheric flares. (auth)

57093 ABSORPTION IN THE LOWER NIGHTTIME IONOSPHERE AS AN INDICATION OF IONIZATION PROCESSES UNDER NORMAL AND DISTURBED CONDITIONS. II. Nestorov, B. (Geophysical Inst., Sofia). Geomagn. Aeron. (USSR) (Eng. Transl.); 12: No. 1, 28-35(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 33-43(1972).

It is demonstrated that excessive absorption at a frequency of 593 kHz can be used to determine the particle flux in the upper atmosphere. The particle flux at heights 90 to 120 km is determined for individual nights with geomagnetic disturbances. The development of the ionization process at these heights is described. An ionospheric disturbance occurs synchronously with a geomagnetic disturbance in the F region and appears later in lower layers. Investigation of absorption in the solar activity cycle shows that at a height of 85 to 90 km there is a peculiar compensation between corpuscular and electromagnetic ionization sources. The relative contribution of individual ionization components is determined. A statistical investigation of nights with excessive absorption shows that the dumping of particles below 120 km is responsible for about 50% of these cases. It is found that geomagnetic activity has no relation to enhanced absorption in winter. Standard curves of nighttime absorption are constructed as a function of equivalent frequency. (auth)

57094 NONLINEAR INTERACTION OF RADIO WAVES IN THE IONOSPHERIC E AND F1 LAYERS. Gurevich, A. V. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 20-7(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 24-32(1972).

The nonlinear interaction of narrow-beam radio waves, produced by a change in electron density in the wave field, is analyzed. It is demonstrated that nonlinear interaction in the lower layers of the ionosphere results in the defocusing of beams. Expressions determining the variations in beam width and field amplitude at the reception site, produced by the defocusing of the beam in the ionosphere, are obtained and analyzed. (auth)

57095 $O(^1D)$ DISTRIBUTION IN THE UPPER ATMOSPHERE. Vlasov, M. N. (Kazan State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 122-4(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 144-5(1972).

It has been established that the main excitation mechanism in the region of the emission maximum of the red O I line is the dissociative recombination of O_2^+ ions and less so of NO^+ ions. The intensity maximum of λ 6300 A emission occurs in the height interval of 200 to 250 km. Unlike other upper atmosphere emissions, that at λ 6300 A is not concentrated in a narrow layer; weak glow is observed also at lower heights down to 70 km. It is difficult to obtain the vertical intensity profile of the red line for low heights against the background of the strong radiation flux from the main layer. It is known that some processes at heights of 60 to 150 km in the upper atmosphere lead to the formation of $O(^1D)$. The equilibrium $O(^1D)$ for concentrations at heights of 60 to 150 km in the upper atmosphere is computed, where the main mechanism for the formation during daytime is photodissociation of ozone and molecular oxygen. The concentrations and production of $O(^1D)$ in the daytime D region are discussed. Nighttime estimates of the concentrations show practically no concentrations below 100 km. (J.C.W.)

57096 RELATIONSHIP BETWEEN THE INTENSITY OF CORPUSCULAR RADIATION AND THE TEMPERATURE OF THE MESOSPHERE AT MIDDLE LATITUDES. Kokin, G. A.; Moiseev, Yu. N.; Tulinov, V. F.; Shapiro, I. G. Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 120-1(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 142-3(1972).

An investigation of the relation between the intensity of corpuscular streams and the thermodynamic parameters and state of the ionosphere was made from simultaneous measurements of atmospheric temperature, pressure, and density (to heights of 80 to 90 km), wind (to about 50 km), some ionospheric characteristics, and corpuscular radiation intensity. A sharp increase in solar activity was observed two times during the testing period on March 27 to 29 and April 18 to 23, 1969. The effect of increased solar activity on the upper atmosphere, ionosphere, and on the intensity of corpuscular radiation was determined. The virtual reflection height of the E and F1 layers was determined with an ionospheric station. A relationship between intensity variations of corpuscular streams and temperature variations in the upper atmosphere was investigated as a function of varying heights. The testing was performed from March 24 to May 21, 1969. (J.C.W.)

57097 LATITUDINAL VARIATIONS OF IONOSPHERIC F-REGION DISTURBANCE IN THE SUBAURORAL ZONE. Mamrukov, A. P. (Inst. of Cosmophysical Investigations and Aeronomy, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 108-10(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 131-3(1972).

Vertical sounding data were used to compile catalogues of ionospheric disturbances over Yakutsk (1956–1969), Zyryanka (Jan.–Mar. 1969), Batagay (June 1968–May 1969), and Tixie (Dec. 1968–March 1969). Analyses of these data were used to determine the latitudinal variation of the frequency and intensity of F-region disturbances, implying that the zone of maximum ionospheric activity in this region is located at $\phi' \approx 62°N$ in winter. The result was obtained without allowance for the diurnal variations of the frequency of occurrence of ionospheric disturbances and the possible dependence on the magnetic disturbance level. Therefore it must be assumed that $\phi' \approx 62°N$ is some average position of the zone of maximum susceptibility of the F region to disturbances in winter during high solar activity. It is usually believed that the ionospheric disturbance maximum is located in the auroral zone, previously determined to move within $\phi' = 67$ to 77°, depending on the time of day. Only the southern boundary of this zone reaches $\phi' = 62°N$ during the daytime when $K_p = 7$ to 7 and at night when $K_p = 3$ to 4. Results indicate that the zone of ionospheric activity on the Yakutsk—Tixie meridian is much farther south than the auroral zone, so there is a second, more southerly zone, or subauroral zone. (J.C.W.)

57098 COMPUTER FORECASTING OF F2-LAYER PARAMETERS. Chernyshev, O. V. (Moscow Electrical Engineering Inst. of Communications). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 106-7(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 127-8(1972).

A method was developed to describe the variations of the F2-layer parameters by means of a finite series of definite functions. As the initial material for the computations, the dependence of monthly median f_0F2 and F2-M-3000 values on the solar activity level, constructed from the results of vertical ionospheric soundings by the global network of stations, was used. From these relationships, the f_0F2 values for relative sunspot numbers W = 0, 100, 150, and 200, and the F2-M-3000 values for W = 0 and 200 were determined. For a fixed solar-activity level, the set of these values for all stations describes the global distribution of the parameters and is approximated from a method by Chernyshev, 1971. Computations obtained represent sets of expansion coefficients reflecting some generalized distribution of the parameters with allowance for extensive experimental data. These sets of expansion coefficients were then used to forecast f_0F2 and F2-M-3000 by a method of Chernyshev, 1969. An evaluation of the forecasting error was made. The accuracy of this forecasting method is higher than other methods. Computations were performed on an M-20 computer. (J.C.W.)

57099 ELECTRIC FIELDS IN THE IONOSPHERE AND IONIZATION DRIFT IN THE F2 REGION. Roldugin, V. K.; Tsirs, V. E. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 104-6(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 125-6(1972).

For a DP system to appear in the high-latitude ionosphere during a disturbance requires an electric field. A study of magnetograms and ionospheric data are used in an attempt to describe the nature of the electric field. If an electric field penetrates into the ionosphere from the magnetosphere, an inflow of charges from the magnetosphere is necessary to sustain a stationary field in the ionosphere; this is equivalent to the presence of currents flowing along lines of force. It was concluded from this that the intensity vector of the electric field in the ionosphere is parallel to the horizontal projection of the total magnetic disturbance vector in the northern and antiparallel in the southern hemisphere. Since conductivity is much higher along than across the lines of force, the height of the electric field in the ionosphere is nearly constant and its magnitude and direction are approximately the same in the F2 region as in the current sheet. Vertical movements are easily traced on ionograms. The variations in F2-layer height were studied from data for Loparskaya. An inverse relation was shown between behavior of critical frequency and height. Sadovnikova concluded that electric fields regenerate in the dynamo E region. From a summary of the data presented, it was concluded that the nature of the relation between the height of the F2 region and the horizontal magnetic disturbance vector supports the hypothesis that the electric field in the ionosphere arrives from the magnetosphere during a DP disturbance. (J.C.W.)

57100 EFFECT OF SOLAR ACTIVITY ON THE GEOMETRIC PARAMETERS OF THE F1 LAYER. Freizon, I. A.; Shapiro, B. S. (Inst. of Terrestrail Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 101-3(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 122-4(1972).

A detailed investigation of the variations of ionization maximum of the F1 layer, h_{max} F1, and its thickness parameter, q_cF1, was made as a function of solar activity. The average diurnal pattern and height of these parameters differ during IGY and IQSY. The N(h) profiles were obtained from vertical soundings of the ionosphere above Moscow during the IGY—IQSY—IYAS (1957—1968) period. The average diurnal variations for each hour were estimated from approximately 10 to 15 magnetically quiet days when the F region was distinctly split. The effect on geometric parameters of nonthermal factors (motion, etc.) is small at the F1-layer level and should not distort the results. A comparison shows that the electron temperature values at the maximum of the F1 layer, obtained from data on its geometric parameters, agree well with experimental and theoretical data on electron temperature for these heights. (J.C.W.)

57101 SPATIAL AND TEMPORAL MANIFESTATION OF THE SEASONAL ANOMALY IN THE TOPSIDE IONOSPHERE. Boyenkova, N. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 99-101(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 119-21(1972).

The latitudinal and temporal manifestations of the seasonal anomaly in the topside ionosphere of the Northern and Southern Hemispheres are examined for all hours of the day from Alouette-1 data. The winter and summer $n_e(h)$ profiles are compared, starting from the level of the electron density maximum of the F2 layer to the altitude of the satellite at 1000 km. The analyses involved 60 satellite passes or more than 400 winter and summer profiles on magnetically quiet days during low solar activity in 1962—1964. All data referred to the American continent (λ = 50 to 120°W). The data on n_e(h) profiles were used to construct a map of the distribution of n_e(h) types as a function of LT and latitude above the American continent. The seasonal anomaly above ~500 km was examined carefully since these data have not been previously published. Data on the duration of the seasonal anomaly in the course of the day, obtained from maximum electron densities in the F2 layer, showed that there was no seasonal anomaly in any hours of the day in the Southern Hemisphere in 1964. Results show no seasonal anomaly at 0 to 9h in the topside ionosphere. (J.C.W)

57102 SUNRISE AND SUNSET EFFECTS OF PROCESSES IN THE SUN—EARTH SPACE. Velinov, P. I. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 5, 605-8(1972).

A dependence between solar activity and natural processes in the Sun—Earth space is mathematically presented, with detailed calculations involving close-Earth environment at sunrise and sunset. Solar activity parameters include sunspot number variations or characteristics of visible, x-ray, corpuscular, and radio radiations of the Sun. The solar activity parameters may be presented at different parts of Sun—Earth space, such as close-Earth surface, ionosphere, above ionosphere, magnetosphere, interplanetary space, or eternal day. It is assumed that the function of solar activity is evenly distributed on the solar disc. (J.C.W.)

57103 EMPIRICAL RESULTS OF DEPENDENCE BETWEEN INTENSITY OF LINE 6300 A AND IONOSPHERIC PARAMETERS. Gogoshev, M. M.; Serafimov, K. B. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 5, 609-12(1972).

A dependence between the new parameters of the ionospheric F region and the intensity of the dissociative-recombination-generated 6300-A oxygen red line in the nightglow is presented. Barbier had presented the dependence relationships in 1963. An empirical determination is presented with the use of observations made of the nightglow at Stara Zagora and ionospheric radio soundings at Michurin and Sofia in 1970. The observation point of the night sky is exactly between the two stations, allowing for the comparison of optical and radio observations. (J.C.W.)

57104 WAVES IN IONOSPHERIC F2 LAYER. Nestorov, G. T. Compt. Rend. Acad. Bulg. Sci.; 25: No. 5, 613-16(1972).

The field strength of the ionosphere-reflected signal from a cw transmitter on frequency 7.67 MHz has been recorded at the Sofia observatory since 1966. Performance of the instrument is such that a small variation in ionization in the F2 layer is recorded. The working frequency is close to the daily critical frequency. At that ratio, f/f_0 F2, the signal's basic absorption is realized in F2 layer. This makes it possible to obtain considerable variations in field strength at small f_0 F2 deviations. The setup manifests itself as an amplifier of anomalies and is a highly sensitive and continuous indicator of the relative f_0 F2 variations, of changes of height h′F2 or of its thickness, as well as of its structure. Quasi-period variations predominate during periods with type-IV bursts, aurorae, sudden geomagnetic storms, or with high geomagnetic activity, and are much less frequent in periods with normal solar and geomagnetic activity. These statistics were made on satellites Cosmos-261 and Intercosmos-2. Tabulations are made of the quasi-period variations on daily and hourly bases. (J.C.W.)

57105 DETERMINATION OF DRIFT IN THE IONOSPHERE. Kushnerevskii, Yu. V.; Samardzhiev, D. T.; Spasov, Khr. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Compt. Rend. Acad. Bulg. Sci.; 25: No. 5, 617-19(1972). (In Russian).

The method of comparisons was used to determine the velocity and direction of drift in the ionosphere, testing only those observations for which amplitude fluctuations of the signals taken with different antennas were similar but were shifted with respect to time. Data previously obtained by one of the authors (May, June, 1970) at frequencies 593 and 1,223 kHz were characterized by a time difference less than unity (from 0.5 to 0.9 sec). Criteria for excluding certain data from the drift computations based on magnitude and sign of the values are discussed. (K.S.W.)

Particle Kinetics and Trapping

Refer also to abstract 57070.

57106 DISPERSIVE AURORAL HISS. Siren, J. C. (Stanford Univ., Calif.). Nature (London) Phys. Sci.; 238: No. 86, 118-19(21 Aug 1972).

At the frequencies of auroral hiss (up to 500 kHz), the propagation of radio energy through the magnetosphere is in the whistler mode, which is dispersive: the velocity of propagation is dependent on frequency. Bursts of auroral hiss so brief as to have distinctly exhibited whistler-mode dispersion are reported. The duration of each of these bursts was of the order of 0.1 s. The name ''fast hisslers'' is adopted to distinguish from the more slowly varying, periodic hissler emissions reported by Carpenter et al. (J. Geophys. Res., 76: 7778(1971)) and to indicate their kinship with auroral hiss. These hisslers were observed at a ground station and therefore differ from the 0.05 s duration ''auroral beam modes'' observed by Smith (Nature, 224: 351(1969)) with the very-low-frequency receiver on the Alouette-II satellite. (auth)

57107 ENERGY RELEASES IN THE UPPER ATMOSPHERE DURING GEOMAGNETIC DISTURBANCES. Krassovsky, V. I. (Inst. of Atmospheric Physics, Moscow). Planet. Space Sci.; 20: No. 9, 1363-7(Sep 1972).

Energy releases in the upper atmosphere during geomagnetic disturbances in the red emission of atomic oxygen and in the hydroxyl emission are considered. (auth)

57108 AURORAL MORPHOLOGY. Davis, T. N. (Univ. of Alaska, College). Planet. Space Sci.; 20: No. 9, 1369-73 (Sep 1972).

It is suggested that a useful description of auroral morphology is obtained by considering four morphological phases; quiet phase, growth phase, expansive (breakup) phase, and recovery phase. The change from the quiet phase to the substorm growth phase is related in many cases to a turning of the interplanetary magnetic field from north to south. (auth)

57109 BEHAVIOR OF OUTER RADIATION ZONE AND A NEW MODEL OF MAGNETOSPHERIC SUBSTORM. Parks, G. K.; Laval, G.; Pellat, R. (Univ. of Washington, Seattle). Planet. Space Sci.; 20: No. 9, 1391-1408(Sep 1972).

Particle data obtained from synchronous altitudes are presented and an evaluation is made of the origin and nature of particle flux variations observed during substorms. The correlated particle intensities, time variations, and energy spectrums are compared between the equatorial and auroral zones. The correlated particle and field observations during substorms are tied together and a model of magnetospheric substorms is derived. Among the features predicted by the model is the poleward expansion of visual auroras observed at the onset of magnetospheric substorms. The model also explains how substorms are triggered in a few minutes time scale during sudden commencements. (auth)

57110 PLASMA SHEET VARIATIONS DURING SUBSTORMS. Hones, Edward W. Jr. (Los Alamos Scientific Lab., N. Mex.). Planet. Space Sci.; 20: No. 9, 1409-31(Sep 1972).

The magnetotail plasma sheet thins down and then becomes thick again at 18 R_E during a magnetospheric substorm. Thinning often starts coincident with (±1 min) substorm onset. Thinning does not involve compression of all of the plasma into a thinner more intense sheet but involves mass motion of plasma away from 18 R_E, some of it leaking into the magnetosheath. Magnetic-field lines from the auroral zone may extend 18 R_E into the tail just before a substorm begins and then contract rapidly toward the Earth early in the substorm. Thickening or ''recovery'' of the plasma sheet is detected by a Vela satellite ~1 or 2 R_E from the neutral sheet as the poleward-moving auroras reach magnetic latitude ≈74°. Plasma-sheet electron fluxes measured at such times with relatively wide-angle detectors appear ~100 times less intense than those measured by rockets and satellites over the expanding auroral oval. There is evidence, however, that the electron flux within a few degrees of the magnetic-field direction in the plasma sheet may be comparable in intensity with observed auroral electron fluxes. (auth)

57111 BEHAVIOR OF LOW-ENERGY PARTICLES DURING SUBSTORMS. Sharp, R. D.; Johnson, R. G. (Lockheed Missiles and Space Co., Palo Alto, Calif.). Planet. Space Sci.; 20: No. 9, 1433-42(Sep 1972).

Recent results on the behavior of low-energy particles near the inner edge of the plasma sheet and the trapping boundary during magnetospheric substorms are reviewed. The major emphasis is on ATS-5 data, and a substorm at 0530 UT on February 13, 1970 is discussed in some detail. (auth)

57112 POLAR MAGNETIC SUBSTORMS. Fukushima, Naoshi (Tokyo Univ.). Planet. Space Sci.; 20: No. 9, 1443-54(Sep 1972).

From the world distribution of geomagnetic disturbance, the connection between the electric current in the ionosphere, the field-aligned current, and asymmetric equatorial ring current in the magnetosphere is discussed. The partial ring current in the afternoon—evening region, whose intensity is closely correlated with the AE-index, usually develops and decays earlier than the symmetric ring current in the course of magnetic storms. The partial ring current seems to have a direct connection with the positive geomagnetic bay in high latitudes in the evening hours through the ionizing effect of the particles leaking from the partial ring current. The dawn-to-dusk electric field in the magnetospheric tail is transferred to the polar ionosphere, producing there the twin vortex Hall current responsible for polar-cap geomagnetic variation. The magnetic effect of the associated Pedersen current in the ionosphere is shown to be small but still worth considering. The electrojet near midnight along the auroral oval is thought to appear when the electric conductivity of the ionosphere is locally increased under the presence of large scale dawn-to-dusk electric field. The occasional appearance of a localized abnormal geomagnetic disturbance with reversed direction near the geomagnetic pole seems to suggest the occasional reversal of electric field near the outer surface of the magnetospheric tail, especially when the interplanetary magnetic field is northward. (auth)

57113 MAGNETIC FIELD FLUCTUATIONS DURING SUBSTORMS. Fairfield, D. H. (Goddard Space Flight Center, Greenbelt, Md.). Planet. Space Sci.; 20: No. 9, 1455-74(Sep 1972).

Before a magnetospheric substorm and during its early phases the magnetic-field magnitude in the geomagnetic tail increases and field lines in the night-time hemisphere assume a more tail-like configuration. Before the substorm onset a minimum amount of magnetic flux is observed to cross the neutral sheet that means that the neutral sheet currents attain their most earthward locations and their greatest current densities. This field configuration apparently results from an increased transport of magnetic flux to the tail caused by a southward interplanetary magnetic field. The field begins relaxing toward a more dipolar configuration at the time of a substorm onset with the recovery probably occurring first between 6 and 10 R_E and later at greater distances. This recovery must be associated with magnetospheric convection that restores magnetic flux to the dayside hemisphere. Field-aligned currents appear to be required to connect magnetospheric currents to the auroral electrojets but such current systems imply that a net current flows in a limited range of longitudes. Space measurements supporting the existence of such current sytems are very limited. Much more evidence exists for the occurrence of double sheets that do not involve net current at a given longitude. (auth)

57114 ELECTRIC FIELD VARIATIONS DURING SUBSTORMS: OGO-6 MEASUREMENTS. Heppner, J. P. (Goddard Space Flight Center, Greenbelt, Md.). Planet. Space Sci.; 20: No. 9, 1475-98(Sep 1972).

The OGO-6 electric-field measurements make it clear that the general pattern of high-latitude electric fields in magnetic time-invariant latitude coordinates is not highly variable and that when unusual variations, or field distributions, occur they are relatively isolated in time and spatial extent. Thus, electric-field changes on a global scale cannot, in general, be invoked as a direct cause of substorms. Polar traverses along the 1800 to 0600 magnetic time meridian show that the sum of potential drops across the evening auroral belt (poleward E) and morning auroral belt (equatorward E) approximately equals the potential drop across the polar cap (dawn to dusk E). The integrated polar-cap potential drop ranges from 20 to 100 keV and values in the center of this range (e.g. 40 to 70 keV) are most common under conditions of moderate magnetic disturbance (e.g., Kp = 3). Roughly near 1800 magnetic local time, a latitudinally narrow strip at the transition between auroral belt and polar-cap fields exhibits unusually large field fluctuations immediately following the sudden onset of a negative bay at later magnetic local times. It appears likely that this spatially isolated correlation is related to an effect rather than a cause of substorm enhancement. Other indications of direct correlation between electric-field behavior and stages of magnetic-bay development have not been found to be repeatable for multiple cases. These preliminary studies do not, however, rule out the possibility that more subtle relationships will be found in future studies. (auth)

57115 MICROPULSATIONS AND VLF EMISSIONS DURING SUBSTORMS. Troitskaya, V. A.; Kleimenova, N. G. Planet. Space Sci.; 20: No. 9, 1499-1519(Sep 1972).

The typical development of the substorm in micropulsations and emissions is described. The growing phase of the substorm is clearly expressed in the generation of series of $\pi 2$ pulsations with characteristic spectra and in the generation or amplification of long period pulsations (T ~ 3 to 7 min) in the region of geomagnetic poles. In this phase, bursts of vlf hiss with f > 2 khz can be observed in the auroral zone. These phenomena are revealed approximately 30 to 60 min before the breakup. The main phase of the substorm is characterized by generation of different types of irregular micropulsations occurring in definite time sequence. Analysis of their amplitude distribution on the Earth's surface and spectra can help to trace the changes in location of precipitation of the soft electrons. The appearance of IPDP indicate deep injection and the western drift of protons. The typical vlf for main phase are vlf hiss with f > 1 khz. Frequently 15 to 20 min after $\pi 2$ near the meridian crossing the $\pi 2$ source a small burst of hiss lasting 20 to 30 min on f < 2 khz is observed (subauroral zone). The recovery phase is clearly expressed in long lasting irregular pulsations, πC or A-A. Their detailed observations on the Earth's surface can yield important information on the regions of precipitation of hard electrons in the morning sector. The most typical vlf phenomena in this phase are chorus that appear after the A—A pulsations. In the polar-cap bursts of vlf hiss can be observed in this phase. (auth)

57116 SUBSTORM RELATED CHANGES IN THE GEOMAGNETIC TAIL: THE GROWTH PHASE. McPherron, R. L. (Univ. of California, Los Angeles). Planet. Space Sci.; 20: No. 9, 1521-39(Sep 1972).

Changes in the configuration of the geomagnetic tail are known to play a fundamental role in magnetospheric substorms. Observations with the UCLA magnetometer on the eccentric orbiter OGO 5 indicate that the most pronounced changes in the midnight meridian occur in the cusp between 8 and 11 R_e. In order to organize the observations it is necessary to separate effects on the tail due to the solar-wind magnetic field and effects due to substorms. Provided there are not changes in the solar wind there are two distinct phases of a substorm in the near tail: a growth phase and an expansion phase. During each phase the observations depend on the location of the satellite relative to the plasma-sheet boundaries. Far behind the Earth is the pure tail region that consists of the lobe and the plasma sheet. In the lobe the field magnitude is characteristically enhanced relative to the dipole. Closer to the Earth is a region of transition. The field magnitude is close to that of the dipole but its orientation is distorted forming a cusplike field line. Near the Earth is a region of depressed field. Here the field magnitude is much less than that of the dipole, but its orientation is similar. The growth phase of a substorm appears to be the direct consequence of the onset of a southward solar-wind magnetic field. In the pure tail region the lobe field begins to increase in magnitude and the plasma sheet thins. The transition region moves earthward and the field lines become more tail-like as the field magnitude increases. In the inner region of depressed field, the field magnitude decreases rapidly. The onset of the expansion phase appears to be a process internal to the magnetosphere and independent of the solar wind. In the depressed field region there is a rapid, turbulent increase in field magnitude. In the transition region there is a sudden decrease in the field magnitude and a return to dipolar orientation. In the tail region the plasma sheet expands rapidly with the field becoming quite dipolar, decreasing slowing in the lobe of the tail. (auth)

57117 NOISE IN THE GEOMAGNETIC TAIL. Russell, Christopher T. (Univ. of California, Los Angeles). Planet. Space Sci.; 20: No. 9, 1541-53(Sep 1972).

Present observations revealed a variety of magnetic-wave phenomena in the tail, from ulf to elf frequencies. However, only vlf measurements of electric fields were made. These measurements reveal that the tail is electrically quiet at vlf frequencies, except in the near-Earth plasma sheet during substorm expansion phases. The magnetic waves observed include: waves with periods of about 2 min that cause the plasma-sheet boundary position and the neutral sheet location to oscillate; waves from 10^{-1} to 1 Hz that occur throughout the plasma sheet during plasma sheet expansions; and elf waves that occur sporadically in the plasma sheet. (auth)

57118 BOW-SHOCK EFFECTS ON PROBE MEASUREMENTS. Lee, S. (Univ. of Malaya, Kuala Lumpur); Sandeman, R. J. J. Appl. Phys.; 43: No. 10, 3980-3(Oct 1972).

Probe measurements of pressure and magnetic field are of importance in electromagnetic-shock-tube diagnostics. The effect of the bow shock on such measurements, in transverse shock wave in the ionizing—hydromagnetic regimes, is considered. The bow-shock jump equations are first solved, then the total stagnation pressure is obtained assuming an isentropic compression towards the stagnation point. The pressure measured at the stagnation point of the probe is seen to be less than the free-stream total gas pressure. The magnetic field is considered in terms of a simple model taking into account the field and flow distributions outside of the stagnation streamline. This analysis shows that the magnetic field measured at a coil is also less than the free-stream magnetic field. (auth)

57119 RADIATION FROM AN ELECTRIC DIPOLE IN ANISOTROPIC MEDIA. Sundaram, A. K. (Physical Research Lab., Ahmedabad, India). J. Appl. Phys.; 43: No. 10, 3964-75(Oct 1972).

Based on the single-fluid theory of magnetohydrodynamics (MHD), the investigation deals with a comparative study on the radiation characteristics of an electric dipole in homogeneous anisotropic media of infinite extent with a uniform magnetostatic field. Attention is specifically focused on the excitation of waves in a frequency range below the ion cyclotron frequency. In the asymptotic evaluation of the far fields, critical cases of the dispersion curves having points of inflection or unbounded branches are briefly considered. The normalized power density as a function of the polar angle θ (being measured from the axis of the magnetic field) is calculated, and it is shown that both compressibility and Hall effects enhance the angular zone of radiation for increasing values of the parameters χ and λ. (auth)

57120 VLF EMISSIONS IN THE MAGNETOSPHERE. Rycroft, M. J. (Univ. of Southampton, Eng.). Radio Sci.; 7: No. 8-9, 811-30(1972).

Recent observations of both naturally occurring and triggered vlf emissions (a few KHz) made on the ground, aboard rockets, and aboard satellites are discussed. Although reference is made to auroral-zone emissions, attention is concentrated on midlatitude discrete emissions such as chorus. Following Brice [1964] and Kennel and Petschek [1966], the signals are interpreted as arising from the transverse resonance (or cyclotron) instability of magnetospheric plasma in the equatorial plane in the vicinity of the plasmapause. The energy of the gyroresonant electrons is estimated; the precipitation of these energetic electrons from the radiation belts is a consequence of the interaction. (136 references) (auth)

57121 MEASUREMENTS OF MAGNETOTAIL PLASMA FLOW MADE WITH VELA 4B. Hones, E. W. Jr.; Asbridge, J. R.; Bame, S. J.; (and others) (Los Alamos Scientific Lab., N. Mex.). J. Geophys. Res.; 77: No. 28, 5503-22(1 Oct 1972).

The flow of plasma in the Earth's magnetotail has been measured with an electrostatic analyzer on Vela 4B at geocentric distances of ~18 R_E. The analyzer on the rotating (64-sec period) satellite measures proton energy spectra from 79 eV to 19 keV, and the plasma flow is detected and measured by the substantial spin modulation that it often causes in the measured proton fluxes. The satellite's spin axis is kept directed radially outward along a radius vector from the Earth, and so the analyzer, whose aperture is in the satellite's equatorial plane, most effectively senses flows in the direction perpendicular to the radius vector. Some results of the measurements are that (1) plasma flow speeds of several hundred km/sec are frequently measured in the plasma sheet, particularly during substorms, and these sometimes approach 1000 km/sec; however, evident flow in a given direction seldom persists for more than a few minutes; (2) these rapid substorm-related flows are usually directed generally sunward; (3) flow in the anti-sunward (tailward) direction is observed early in some substorms as the plasma sheet thins down; this may suggest the formation of a neutral line at geocentric distances <18 R_E; (4) the magnetotail is separated from the surrounding magnetosheath by a boundary layer a few thousand kilometers thick in which magnetosheath-like flow occurs but at reduced particle density and velocity; and (5) averaging of all flow measurements made in the plasma sheet over many months does not reveal any distinct pattern or flow either sunward or anti-sunward; an average of the flows observed during periods of a few minutes of clearly evident flow, however, does reveal a flow in the general direction of the Sun. It appears that the plasma sheet may often be in turbulent motion with turbulence-cell dimensions no greater than a few R_E. (45 references) (auth)

57122 PARASITIC PITCH-ANGLE DIFFUSION OF RADIATION-BELT PARTICLES BY ION CYCLOTRON WAVES. Lyons, Lawrence, R.; Thorne, Richard Mansergh (Univ. of California, Los Angeles). J. Geophys. Res.; 77: No. 28, 5608-16(1 Oct 1972).

The resonant pitch-angle scattering of protons and electrons by ion cyclotron turbulence is investigated. The analysis is analogous to that recently performed for electron interactions with whistler-mode waves. The role played by the intense band of ion cyclotron waves, predicted to be generated just within the plasmapause during the decay of the magnetospheric ring current, is evaluated in detail. Loss rates resulting from parasitic interactions with this turbulence are determined for energetic protons and relativistic electrons. (25 references) (auth)

57123 CYCLOTRON DRIFT INSTABILITY IN THE BOW SHOCK. Wu, C. S. (Univ. of Maryland, College Park); Fredricks, R. W. J. Geophys. Res.; 77: No. 28, 5585-9(1 Oct 1972).

It is argued that the cyclotron drift instability (coupled ion waves and electron Bernstein modes) can explain many structural features of the weak electrostatic turbulence observed in bow shock magnetic-field gradients and, thus, that it provides a more attractive speculation than the ion acoustic or Buneman instabilities previously suggested as weak turbulence sources. (auth)

57124 OUTER MAGNETOSPHERE NEAR MIDNIGHT AT QUIET AND DISTRUBED TIMES. Aubry, Michel P. (Univ. of California, Los Angeles); Kivelson, Margaret G.; McPherron, Robert L.; Russell, Christopher T.; Colburn, David S. J. Geophys. Res.; 77: No. 28, 5487-5502(1 Oct 1972).

Ogo 5 magnetic-field and energetic-electron ($E > 50$ keV) data were used to study both the quiet-time, steady-state configuration of the outer magnetosphere or near-tail region near midnight and the disturbed time changes of this configuration. The nighttime cusp is found to be a distinct feature within the plasma sheet at quiet times but indistinguishable from the plasma sheet at disturbed times. The sequence of thinning and expansion of the plasma sheet in this region in association with the substorms is studied. The response of the plasma sheet in the near tail at $\sim 10\ R_E$ is found to be similar to that in the more distant tail at $> 20\ R_E$. Finally, the nature of field-aligned currents flowing on the plasma-sheet boundary is investigated. Assuming infinite current sheets, the sheet current density at Ogo 5 is found to be approximately 10^{-2} amp m^{-1}. At ionospheric altitudes in the auroral zone, these currents scale to 10^{-1} amp m^{-1}, in good agreement with low-altitude measurements. These currents in space often appear in double or multiple sheets. (23 references) (auth)

57125 EVIDENCE OF A DIFFUSE MAGNETOPAUSE BOUNDARY. Intriligator, D. S. (California Inst. of Tech., Pasadena); Wolfe, J. H. J. Geophys. Res.; 77: No. 28, 5480-6(1 Oct 1972).

Observational evidence is presented to show that the magnetosphere—magnetopause boundary was diffuse during the Pioneer-8 magnetopause traversal on December 14 and 15, 1967. This boundary was characterized by proton fluxes of significantly lower intensity than those observed in the magnetosheath. In addition, the angles of flow associated with the fluxes at the boundary were more diverse than those observed in the magnetosheath. Proton energy spectra are presented to indicate the change in the spectral shape at the boundary. The observational evidence is consistent with calculations by Axford and Dryer of a viscous magnetopause boundary layer, which is a function of an anomalous nonclassical kinematic viscosity. The observational evidence presented for the diffuse magnetosphere boundary may also be consistent with Dungey's model for reconnection of magnetic-field lines and an open magnetosphere. (auth)

57126 BINARY INDEX FOR ASSESSING LOCAL BOW SHOCK OBLIQUITY. Greenstadt, E. W. (TRW Systems Group, Redondo Beach, Calif.). J. Geophys. Res.; 77: No. 28, 5467-79(1 Oct 1972).

The Earth's collisionless plasma bow shock has, overall, a nonuniform structure whose magnetic profile is simultaneously that of a monotonic or laminar perpendicular shock and of a multigradient oblique shock, depending on the local orientation of the interplanetary field to the nominal shock surface. A "pulsation index" I_p has been devised from empirical results to provide a simple convenient means of assessing the probable local character of the shock's structure; $I_p = 0$ or 1, according to whether local field geometry favors perpendicular or oblique structure, respectively, at a chosen point of observation on the nominal shock surface. Computation of the index begins with an average hyperbolic shock, changes its scale appropriately to place the observation point on the shock, finds the orientation of the interplanetary field B_{SW} to the shock at the observation point (from upstream measurements) in a plane containing B_{SW} and the solar ecliptic X axis, and assigns a value 1 or 0 to I_p, depending on whether protons reflected from the shock with velocity p times the solar-wind speed along B_{SW} will or will not remain in the solar wind ahead of the shock. Examples in which the index has been applied demonstrate the utility of the index, the consistency of appearance of oblique structure when the index predicts it, and an empirical preference for $p \approx 1.6$. (auth)

57127 USE OF THE THREE-DIMENSIONAL CONVARIANCE MATRIX IN ANALYZING THE POLARIZATION PROPERTIES OF PLANE WAVES. Means, Joseph D. (Univ. of California, Los Angeles). J. Geophys. Res.; 77: No. 28, 5551-9(1 Oct 1972).

A technique for analyzing the polarization properties of plane waves that offers a number of advantages over methods currently used in the analysis of both ground and satellite observations of waves is developed. This technique reduces the computations required to find the wave normal vector, is less sensitive to common noise sources, and is amenable to analog implementation. The technique here is applied specifically to the analysis of a proton whistler, but it can also be used in most studies of ulf, elf, and vlf magnetic-wave phenomena. (35 references) (auth)

57128 ANNUAL VARIATION OF THE INTERPLANETARY He^+ VELOCITY DISTRIBUTION AT 1 AU. Feldman, W. C.; Goldstein, D.; Scherb, F. (Univ. of Wisconsin, Madison). J. Geophys. Res.; 77: No. 28, 5389-98(1 Oct 1972).

The interplanetary velocity distribution of He^+ ions of interstellar origin is calculated for various ecliptic longitudes Φ at 1 AU and for various temperatures T of the local interstellar medium. For concreteness we assume a relative streaming velocity of the local interstellar medium with respect to the sun of $\langle V_\infty \rangle = 10$ km/sec oriented in the ecliptic plane, $n_{He}(r = \infty) \simeq 0.005\ cm^{-3}$, and interaction with magnetic irregularities convected by the solar wind is neglected. It is found that these He^+ fluxes should be observable at 1 AU with present observation techniques and that, if $T \simeq 100$ K, they should exhibit sharp peaks in velocity space that vary systematically with Φ. If $T \simeq 5000$ K, He^+ fluxes should appear almost structureless except for a well-defined high-energy cutoff. The annual variation of He^+ flux at this cutoff should exhibit a maximum in the anti-apex direction, with maximum to minimum ratio of 6:1, and $\Delta\Phi_{FWHM} = 70°$ for $T = 5000$ K (FWHM is full width at half maximum). (auth)

57129 MODEL FOR THE UNEVEN ILLUMINATION OF POLAR CAPS BY SOLAR PROTONS. Gall, Ruth; Bravo, Silvia; Orozco, Adolfo (National Univ. of Mexico, Mexico City). J. Geophys. Res.; 77: No. 28, 5360-73(1 Oct 1972).

A model for the uneven illumination of polar caps by solar proton fluxes of 5 to 300 MeV is proposed. It is based on observations and on the assumption that cosmic rays move with the direct mode in the geomagnetic field. Theoretical characteristics of the illumination are derived from extensive computations of cosmic-ray orbits, of points of access and directions of approach at the boundary and the tail, for arrival at all local times in auroral and polar latitudes at satellite heights. The model applies to the anisotropic phase of the proton event. A preferential flow of the anisotropic radiation along the neutral sheet, a preferential flow along the main body of the tail, and reconnection with the interplanetary field are necessary for the model to account for auroral peaks, polar peaks, and north—south asymmetry, respectively, the valleys being illuminated only by the nonanisotropic fraction of the interplanetary flux. The model implies that illumination by the direct impact of the anisotropic flux through the sunlit magnetopause is inhibited. (25 references) (auth)

57130 DYNAMICS OF THE MAGNETOSPHERE AND TYPE Pc5 GEOMAGNETIC PULSATIONS. Raspopov, O. M.; Afanas'eva, L. T.; Kiselev, B. V.; Loginov, G. A. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 128-31(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 150-2(1972).

The excitation of Pc5 is regarded as a result of the development of processes inside the magnetosphere or as a consequence of the interaction of the solar wind with the magnetosphere boundary. Experimental data contradicts the latter view, and it was shown that Pc5 sources are also associated with processes developing inside the magnetosphere during geomagnetic disturbances. The relationship between Pc5 excitation and the development of auroral magnetic disturbances in the nighttime magnetosphere was investigated from the analysis of standard magnetograms from the Murmansk, College, and Tixie observatories for 1959. Results show that pulsations of the Pc5 type are typical of the disturbed state of the magnetosphere. Their generation is always accompanied by the development of disturbances in the dark region of the magnetosphere. For Pc5 with an amplitude <200 γ there is a nearly linear relationship between their amplitude and the amplitude of baylike disturbances. In many cases global auroral activity decreases somewhat at the time of Pc5 excitation. Conditions during intense disturbances are unfavorable to the generation of pulsations. A direct relationship is suggested between Pc5 excitation and the development of geomagnetic disturbances in the dark part of the magnetosphere and, consequently, that Pc5 sources are of intramagnetosphere origin. (J.C.W.)

57131 EFFECT OF LONGITUDINAL CURRENTS ON MAGNETIC DISTURBANCE IN THE POLAR CAP. Lyatskii, V. B.; Mal'tsev, Yu. P. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 70-3(1972).

Translated from Geomagn. Aeron.; 12: No. 1, 83-7(1972).

The magnetic field produced in the polar cap by currents flowing along lines of force in the magnetosphere during a polar substorm is computed. It is demonstrated that the effect of longitudinal currents can explain the apparent discrepancy between the results of experimental measurements of ionospheric electric fields with barium clouds and ground-based magnetic observations. (auth)

Solar Wind and Cosmic Ray Interactions

Refer also to abstracts 56868 and 57082.

57132 INTERACTION OF THE SOLAR-WIND SHOCK WAVE WITH THE EARTH'S MAGNETOSPHERE. Grib, S. A. (IZMIRAN, Leningrad). Dokl. Akad. Nauk BSSR; 16: No. 6, 493-6(Jun 1972). (In Russian).

The reaction of the shock wave of the solar wind, caused by the sudden commencement of a magnetic storm, with the magnetosphere of the Earth was examined. As a result of the interaction of the plane magnetohydrodynamic shock wave, penetrating into the transition layer from the magnetosphere boundary, with the reflected wave with leading front, a rarefaction wave is formed that produces a lowered pressure in the magnetosphere. The decline of the geomagnetic field during a magnetic storm may be explained in terms of such a wave. (tr-auth)

57133 ASSOCIATION BETWEEN INTERPLANETARY SHOCK WAVES AND DELAYED SOLAR-PARTICLE EVENTS. Datlowe, Dayton (Univ. of Chicago). J. Geophys. Res.; 77: No. 28, 5374-84(1 Oct 1972).

The study of the propagation of energetic charged particles from a large solar flare indicates the interplanetary medium cannot be regarded as remaining in a steady state: disturbances in the flow of solar wind from these flares may have great effects on the observed fluxes of charged particles. Delayed particle events, also known as "energetic storm particle" events, may exhibit an increase by an order of magnitude or greater in the flux of protons above 10 MeV over a period of the order of 6 hours. These events are seen in association with the passage of an interplanetary shock past the Earth. The passage of a "corotating region" and trapping of particle fluxes in the interplanetary blast wave are considered and found to be unable to account for the origin of these events. It is therefore proposed that the particles are accelerated locally at the time of the passage of the interplanetary blast wave. (43 references) (auth)

57134 ANNUAL AND SOLAR-MAGNETIC-CYCLE VARIATIONS IN THE INTERPLANETARY MAGNETIC FIELD, 1926–1971. Wilcox, John M.; Scherrer, Philip H. (Stanford Univ., Calif.). J. Geophys. Res.; 77: No. 28, 5385-8(1 Oct 1972).

The polarity of the interplanetary magnetic field has been inferred by Svalgaard (1972) from observations of the polar geomagnetic field during the interval 1926–1971. On the basis of a few years of spacecraft observations, Rosenberg and Coleman (1969) have suggested that there may be an annual variation in the predominant polarity (toward or away from the Sun) of the interplanetary field. The present analysis of 45 years of inferred field polarity clearly shows an annual variation and also a variation of about 20 years, which is associated with the solar-magnetic cycle. On the average the phase of the annual variation of the interplanetary field changes about 2⅔ years after sunspot maximum, i.e., for about 10 consecutive years the predominant polarity of the interplanetary field is away from the Sun during the 6-month interval in which the Earth is at southern heliographic latitudes, and then a change of phase occurs such that for about the next 10 years the predominant polarity is toward the Sun while the Earth is at southern heliographic latitudes. The annual variation changes its predominant polarity within a few days of the times when the heliographic latitude of the Earth is 0. (auth)

57135 ELECTROMAGNETIC INSTABILITIES PRODUCED BY NEUTRAL-PARTICLE IONIZATION IN INTERPLANETARY SPACE. Wu, C. S.; Davidson, R. C. (Univ. of Maryland, College Park). J. Geophys. Res.; 77: No. 28, 5399-5406(1 Oct 1972).

The consequence of the ionization (e.g., photoionization) of a small population of neutral atoms (hydrogen or helium) in interplanetary space is examined. It is found that, even if the density of the newly ionized particles is only a very small fraction of that of the solar wind, these particles can efficiently excite electromagnetic waves by means of a new collective instability. The instability is driven by an anisotropy in kinetic energy of the newly ionized particles. The typical linear growth rate is $\gamma \simeq (\omega_{in}/2^{1/2})(\nu_{0\perp}/c)$ where ω_{in} is the plasma frequency of the newly ionized ions, and $\nu_{0\perp}$ is the characteristic speed of the newly ionized ions perpendicular to the ambient magnetic field in the frame of the solar wind. (auth)

57136 INTERACTION OF THE SOLAR WIND WITH THE NEUTRAL COMPONENT OF THE INTERSTELLAR GAS. Holzer, Thomas E. (NOAA Environmental Research Labs., Boulder, Colo.). J. Geophys. Res.; 77: No. 28, 5407-31(1 Oct 1972).

A model is constructed to represent the interaction between the solar wind and the neutral component of the interstellar gas. It is found that the neutral gas has several important effects on the solar-wind expansion beyond the orbit of the Earth and that it should be possible to infer the presence of the neutral gas from observations of the solar wind made by a space probe traveling into the outer solar system. The effects include a deceleration and heating of the supersonic solar wind, a cooling of and pressure reduction in the subsonic solar wind, and a tightening of the spiral magnetic field in the supersonic solar wind. Although, in principle, the neutral gas can lead to a shock-free transition from supersonic to subsonic flow, it appears that in practice a shock is present. The minimum distance to the shock is estimated to be less than 50 AU and probably more than 25 AU. (44 references) (auth)

57137 ENERGY AND MASS CONTENT OF HIGH-SPEED SOLAR-WIND STREAMS. Montgomery, Michael D. (Los Alamos Scientific Lab., N. Mex.); Bame, S. J.; Hundhausen, A. J. J. Geophys. Res.; 77: No. 28, 5432-41(1 Oct 1972).

The mass and energy flux densities of the solar wind measured by the Vela-3, Vela-4, and Explorer-34 satellites between July 1965 and October 1969 have been examined. Three-hour averages were used to study the properties of large-scale high-speed streams, and 27-day averages were employed in an attempt to identify long-term trends during the rising part of the current 11-year solar cycle. If the cross-sectional area of a stream is estimated by assuming that its extent in heliocentric latitude is the same as its extent in longitude, the total energy (at 1 AU) and mass flux can be calculated by integrating the excess mass and energy flux density above the predisturbance level during corotation of the stream past the observing satellite. The average energy and mass fluxes for dominant high-speed streams are found to be 9×10^{25} erg/sec and 8×10^{9} g/sec, respectively. The total mass and energy output of all streams emanating from the Sun over a typical 27-day interval, assuming that all last for the entire 27 days, is estimated to be less than 10% (~7%) of the total solar-wind output from the same range of heliocentric latitudes (generally ±15°). Both large-scale streams and interplanetary shocks are found to contribute relatively little to 27-day average values of either mass or energy flux density. Thus, even though the amount of mass or energy or both per disturbance appeared to increase with increasing solar activity, the solar-wind energy and mass flux density averaged over a solar rotation remained remarkably constant. (auth)

57138 COMPRESSIONS AND RAREFACTIONS IN THE SOLAR WIND: VELA 3. Gosling, J. T. (National Center for Atmospheric Research, Boulder, Colo.); Hundhausen, A. J.; Pizzo, V.; Ashbridge, J. R. J. Geophys. Res.; 77: No. 28, 5442-54(1 Oct 1972).

Large non-shock-associated proton density enhancements in the solar wind observed by the Vela 3 satellites have been studied by a superposed epoch analysis. The enhancements typically represent a threefold increase above the nominal average density of 7 protons cm^{-3}, are short lived (of ~1-day duration), and are followed by an extended period (~4 days) of depressed densities (≈5 protons cm^{-3}). Associated with the 25 enhancements studied are large positive velocity and proton temperature gradients arising from low-speed (≈335 km sec^{-1}) cool ($\sim 4 \times 10^{4}$°K) flows. At times there is also a very sharp shift in the flow direction associated with the density enhancement, the flow swinging briefly several degrees to the east ahead of the enhancement and then several degrees to the west on its trailing edge. The total average event, i.e., compression and rarefaction, represents a net proton particle flux increase of about 24% over the nominal average value of 2.5×10^8 protons cm^{-2} sec^{-1}. Of the 25 events studied, 17 occur within 1 day of the passage of an interplanetary field sector boundary. The space–time profiles of these events compare favorably with nonlinear models of a hot fast solar-wind stream simultaneously overtaking a cold slow-moving stream ahead while out-running slower-moving plasma behind. The heating associated with the compression at the leading edge of the high-speed stream appears to account for about one-half of the temperature rise found there. Although there is some evidence for a small coronal density signal associated with these events, the major density variations can best be interpreted as the result of a spatial rearrangement of material within the solar wind in transit from the Sun to the Earth. The measurements are consistent with the viewpoint that low solar-wind speeds frequently originate above the coronal magnetic loops joining photospheric regions of opposite polarity and high speeds originate in the diverging-field interstreamer regions. (38 references) (auth)

57139 MODIFICATION OF THE RANKINE–HUGONIOT RELATIONS FOR SHOCKS IN SPACE. **Chao, Jih Kwin (Goddard Space Flight Center, Greenbelt, Md.); Goldstein, Bruce. J. Geophys. Res.; 77: No. 28, 5455-66(1 Oct 1972).**

The Rankine–Hugoniot (R–H) equations for hydromagnetic shocks are extended to take into consideration the energy flux and momentum flux due to waves and/or turbulence and/or heat flow in the vicinity of shocks. Eighteen shocks observed in space were analyzed. It is found that, in order to satisfy the R–H relations with the values of measured parameters in space, waves and/or turbulence and/or heat flow are needed for the shocks with a Mach number of >2, and no waves and/or turbulence are needed to satisfy the R–H equations for the shocks with a Mach number of <2. A discussion of the waves, turbulence, and heat flow is given. Fluctuations may considerably affect the time-averaged R–H relations. A method is used to obtain the thermal anisotropies when Alfvén waves are present in the vicinity of the shocks. For the preshock of August 30, 1967, observed by Mariner 5, it is estimated that the anisotropy parameters should be 0.6 ± 0.2. (25 references) (auth)

57140 SOLAR-WIND VELOCITY FROM IPS OBSERVATIONS. **Coles, W. A.; Maagoe, Steffen (Univ. of California, San Diego, La Jolla). J. Geophys. Res.; 77: No. 28, 5622-4 (1 Oct 1972).**

The solar-wind velocity was measured daily from March to June 1972 by using interplanetary scintillation (IPS) of the radio sources 3C 48 and 3C 144, which have ecliptic latitudes of +21° and −1°, respectively. Preliminary results show that the velocity is higher and more variable in the direction of the high-latitude source but that there is no significant deviation from radial outflow. (auth)

57141 DETECTION OF EARTHWARD FLOW OF keV PROTONS IN THE GEOMAGNETIC TAIL AT LUNAR DISTANCES. **Prakash, A. (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res.; 77: No. 28, 5633-7(1 Oct 1972).**

Data were examined from Explorer 35 reporting the detection of a bulk flow of protons of energies between 0.1 and 3 keV toward the Earth (or Sun) in the geomagnetic tail at lunar distances ($\sim 60\ R_E$). Whenever a flow of protons toward the Earth is detected, the spacecraft is in the vicinity of the neutral sheet. The converse is not always true. It is found that the frequency of occurrence of earthward flow is greater for traversals of the tail that took place during geomagnetically active periods, as determined from the AE index. The present observations implicate the theory of magnetic merging, used to describe the physics of the far geomagnetic tail and of solar flares. It is assumed that the observed flow occurred throughout the breadth ($\sim 45\ R_E$) of the tail in a region $\sim 0.2\ R_E$ thick, the rate of flow of energy toward the Earth was $\sim 1.6 \times 10^{16}$ ergs/sec, where the energy density nkT has been calculated with $n \sim 0.1\ cm^3$ and $kT \sim 1$ keV. (J.C.W.)

57142 SOLAR WIND AND THE MAGNETOSPHERE. **Rues, D. pp 322-56 of Uebersichtsbeitraege zur Gasdynamik. /Leiter, E. (ed.). Vienna; Springer-Verlag (1971). (In German).**

The subject is reviewed under the following topics: hydrodynamic theory of the solar wind; corpuscular theory for interaction of the solar wind with the magnetosphere; magnetogasdynamic considerations of the interaction of the solar wind with the magnetosphere; nonstationary phenomena in magnetosphere disturbances; and conclusions. (169 references) (L.M.T.)

57143 CHARGED-PARTICLE PROPAGATION IN A SCATTERING MEDIUM WITH A CONSTANT AND VARIABLE TRANSPORT MEAN FREE PATH WITH ALLOWANCE FOR MAGNETIC FOCUSING. **Vernov, S. N.; Gorchakov, E. V.; Timofeev, G. A. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 1-6(1972).**

Translated from Geomagn. Aeron.; 12: No. 1, 3-8(1972).

The propagation of particles, injected by a point source, in a radial magnetic field (r^{-2} law) is analyzed. The scattering properties of the medium are described by the transport mean free path of particles, which is assumed to be constant in some cases and variable in others. The results of the computations are used to interpret experimental data on solar proton flares. (auth)

57144 INHOMOGENEOUS SOLAR WIND. **Smirnov, L. P.; Shabanskii, V. P. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 1, 7-12(1972).**

Translated from Geomagn. Aeron.; 12: No. 1, 9-17(1972).

A solar wind that is inhomogeneous in the plane of the ecliptic is analyzed in the hydrodynamic approximation. No allowance is made for viscosity, thermal conductivity, and the effect of the magnetic field. It is demonstrated that an inhomogeneity in the plasma velocity and density distribution may appear within a sector of the interplanetary magnetic field at the orbit of the Earth and the solar wind may not be radial as a result of the development in space of linear disturbances of the corresponding parameters caused by inhomogeneous plasma outflow from the solar corona. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 55739, 55817, 57797, and 57809.

57145 PRODUCTION AND DETECTION OF AN ENERGY-SELECTED BEAM OF HYDROGEN ATOMS IN THE RANGE 0.01 TO 0.20 eV. Aquilanti, V.; Liuti, G.; Luzzatti, E.; Vecchio-Cattivi, F.; Volpi, G. G. (Univ., Perugia, Italy). Z. Phys. Chem. (Frankfurt); 79: No. 3-4, 200-8(Jul 1972).

An intense beam of hydrogen atoms in the thermal energy range is produced by microwave discharge, velocity selected mechanically by rotating slotted discs, and detected by quadrupole mass spectrometry. Details of the apparatus and characteristics of the beam are described. As a typical application, the results for the energy dependence of absolute total cross sections for collisions between H and argon are reported, and their implication for the assessment of the H—Ar intermolecular potential is briefly discussed. (auth)

57146 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 7, NO. 7, 1972. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 75p.

This listing contains 274 references on various aspects of the title subject. (M.O.W.)

57147 PRODUCTION OF INTENSE ION BEAMS BY HIGH-FREQUENCY ELECTRIC FIELDS. Sindoni, E.; Eubank, H. P. (Princeton Univ., N. J.). J. Plasma Phys.; 7: No. 3, 435-44 (Jun 1972).

An experimental investigation is presented of electron cyclotron resonance plasma accelerators as a source of high-intensity, low-energy (keV) ions in which ion current and electron and ion energies are related to rf power and gas pressure. (auth)

57148 LIMITING CURRENT OF AN UNCOMPENSATED RELATIVISTIC ELECTRON BEAM. Mkheidze, G. P.; Pulin, V. I.; Raizer, M. D.; Tsopp, L. E. (Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 63: No. 1, 104-6(Jul 1972). (In Russian).

The limiting current of an electron beam in the absence of compensating ions passing through a vacuum drift tube is investigated for electron energies of 600 keV and for various ratios of tube radius to beam radius. For external magnetic field strengths such that $H_0 \geq 2000$ Oe the limiting currents are in good agreement with the calculated values. (auth)

57149 SCATTERING OF PROTONS IN A THIN GOLD SINGLE CRYSTAL. Zhukova, Yu. N.; Iferov, G. A.; Tulinov, A. F.; Chumanov, V. Ya. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 63: No. 1, 217-23(Jul 1972). (In Russian).

The results of an experimental investigation of scattering of 200- and 500-keV protons in thin gold single crystals are presented. The angular distributions of particles scattered are obtained for various angles of incidence of the beam on the target. A qualitative interpretation of the dependence of the general pattern of the experimental distributions obtained on the angle of incidence is presented, based on the interaction between the ions and single chains of atoms. (auth)

57150 CHARGED PARTICLE SPUTTERING: DISTORTION OF TRAJECTORIES BY THE INCIDENT BEAM FIELD. Bryce, P.; Kelly, J. C. (New South Wales Univ., Kensington, Australia). J. Phys., C (London); 5: No. 13, 1604-14(10 Jul 1972).

A model is presented for calculating trajectory deflections of sputtered particles due to the incident-beam electrostatic field. The resultant deflection of particles prior to detection makes the sputtering current density a significant parameter in analysis of the angular distribution and energy of sputtered particles. Thus it is probable that the high average energies of sputtered ions generally found (in comparison with neutral-particle energies) is partially a result of detector discrimination against particles of a few eV. Angular corrections are given for the most important sputtered energy range up to 20 eV. (auth)

57151 ANGULAR DISTRIBUTION OF INELASTICALLY REFLECTED ELECTRONS. Bronshtein, I. M.; Stozharov, V. M.; Pronin, V. P. (State Pedagogical Inst., Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 4, 927-30(Oct 1972).

Translated from Fiz. Tverd. Tela; 14: No. 4, 1083-6(Apr 1972).

A study was made of the angular distribution of inelastically reflected electrons for Al, Cu, Mo, and W in the range of primary electron energies $E_p = 0.5$ to 3 keV and in the range $\varphi = 0$ to 85° of angles of incidence of the electrons on the target. It is shown that a group of inelastically reflected electrons scattered at large angles is observed for all φ values in Al, Cu, and Mo ($E_p = 0.5$ keV), while for W such a group is observed only at large φ. At $E_p = 3$ keV, for Al only small-angle scattering takes place. For W, a group of inelastically reflected electrons scattered at large angles is observed for all φ; for Cu, such a group is observed only at large φ. (auth)

Atomic and Molecular Properties

Refer also to abstracts 57446, 57776, and 57989.

57152 BOUND STATES OF THE HYDROGEN ATOM AS THE EIGENSTATES OF A FOUR DIMENSIONAL HARMONIC OSCILLATOR SUBJECTED TO A CONSTRAINT. Boiteux, Michel (Univ., Paris). Compt. Rend., Ser. A; 274: No. 14, 867-9(5 Apr 1972). (In French).

The Kustaanheimo—Stiefel transformation is generalized for the quantum case. The problem of the three-dimensional hydrogen atom is shown to be closely linked to that of the four-dimensional harmonic oscillator. (auth)

57153 FROZEN-CORE APPROXIMATION FOR DIATOMIC MOLECULES: THE LOWEST $^1\Sigma^+$ STATES OF H_2. Jackson, M. (York Univ., Toronto); McEachran, R. P.; Cohen, M. J. Phys., B (London); 5: No. 5, 927-33(May 1972).

Adiabatic potential energies for the two lowest $^1\Sigma^+$ states of the hydrogen molecule were calculated in the frozen-core approximation over a range of internuclear separations from 0.2 to 4 au. The results are comparable with the self-consistent-field calculation of Coulson for the $X^1\Sigma_g^+$ ground state and with the multiconfiguration calculation of Browne for the $B^1\Sigma_u^+$ excited state. Transition moments for the $X^1\Sigma_g^+ - B^1\Sigma_u^+$ electronic transition were also computed. (auth)

57154 STUDY OF THE TRANSITIONS OF THE 6 $^3P_1$ AND 6 $^3P_2$ STATES IN A XENON DISCHARGE. Wieme, W. Ghent; Ghent Rijksuniversiteit (1971). 175p. (In Dutch).

Thesis.

Long-living energy-level transitions in rare-gas discharges are studied. The pulsed high-voltage apparatus is described. (auth)

57155 PHOTOIONIZATION OF HELIUM ABOVE THE n = 2 THRESHOLD. Jacobs, V. L.; Burke, P. G. (Queen's Univ. of Belfast). J. Phys., B (London); 5: No. 4, L67-70(Apr 1972).

The partial photoionization cross sections and the angular distribution asymmetry parameter for photoelectrons ejected from helium in the transitions to the n = 2 states of the He^+ ion are calculated for incident photon energies from just above the threshold to 160.6 eV. Good agreement is obtained with experiment. (auth)

57156 IDENTIFICATION OF SOME LINES ARISING FROM DOUBLY EXCITED STATES OF HELIUM. McCavert, P.; Rudge, M. R. H. (Queen's Univ. of Belfast). J. Phys., B (London); 5: No. 4, 832-8(Apr 1972).

A theoretical assessment of the beam—foil measurements of Berry et al., (Phys. Rev., A3: 1934(1971)) is made. It is concluded that the line at 293.8 Å is not due to the $(23sp^-)^1P - 2^1S$ transition. Alternative identifications of some of the experimentally observed lines are proposed. (auth)

57157 VACUUM ULTRAVIOLET ABSORPTION MEASUREMENTS ON IONIZED SPECIES. Hildum, J. S.; Cooper, J. (Univ. of Colorado, Boulder). J. Quant. Spectrosc. Radiative Transfer; 12: No. 10, 1453-5(Oct 1972).

By using a new continuum light source it is now possible to obtain absorption spectra of ionized species. As an illustration, a spectrum of ultraviolet lines of C II, Si II and Si III is shown. (auth)

57158 CORRELATED PHOTONS IN CASCADE AND COLLISIONAL RELAXATION. Lewis, E. L. (Univ. of Newcastle upon Tyne, Eng.). Phys. Lett.; 41A: No. 2, 119-20(11 Sep 1972).

It is shown that collisional depolarization of an excited state influences the effective lifetime of the state as determined from the correlation between photons in cascade and can yield information as to the angular properties of the interactions between perturbers and the excited system. (auth)

57159 LEAST-SQUARES METHOD FOR UNBOUND STATES. Read, F. H. (Univ. of Manchester, Eng.). J. Phys., B (London); 5: No. 7, 1359-68(Jul 1972).

The least-squares variational method has been shown to be a conceptually and computationally simple means of calculating accurate energies and wave functions for the unbound $2s^2\ {}^1S$ and $2p^2\ {}^1S$ states of He. It has also been used, with basis set functions that are asymptotically correct to a high order, to calculate energies and wave functions of the ground state of H^- and of the ground state and several excited bound states of He. (auth)

57160 TERM DEPENDENCE OF HARTREE–FOCK RESULTS FOR SOME nln'l CONFIGURATIONS. Froese Fischer, C. (Univ. of Waterloo, Ontario). J. Phys., B (London); 5: No. 7, 1302-7 (Jul 1972).

Hartree–Fock results for all the LS terms of He 1s2s, C 2p3p, and Ca 3d4d are analyzed. No marked term dependence is observed. Instead, radial functions are found to depend strongly on whether or not the term is allowed when the electrons are equivalent. (auth)

57161 THEOREM ON THE HARTREE–FOCK EQUATIONS FOR THE nsms ^1S STATES OF HELIUM WITH ORTHOGONAL ORBITALS. Rebelo, I. (Oxford Univ.); Sharma, C. S. J. Phys., B (London); 5: No. 7, 1286-92(Jul 1972).

A theorem is proved which shows that the Hartree–Fock orbitals for the nsms ^1S states of helium can be assumed orthogonal if, and only if, the zero-order total two-electron wave function in a perturbation expansion in powers of 1/Z, where Z is the nuclear charge, is a certain linear combination of $ns^2\ {}^1S$, nsms ^1S, and $ms^2\ {}^1S$ zero-order wave functions. This provides some insight into the nature of constrained Hartree–Fock wave functions. The weights of $1s^2\ {}^1S$ and $2s^2\ {}^1S$ states in the total zero-order wave function for obtaining orthogonal orbitals for the particular case of the 1s2s ^1S state are computed numerically. (auth)

57162 PHOTOIONIZATION OF HELIUM: STUDY OF He + $h\nu = He^+(n = 2) + e$. Krause, M. O.; Wuilleumier, F. (Oak Ridge National Lab., Tenn.). J. Phys., B (London); 5: No. 7, L143-5(Jul 1972).

Simultaneous excitation and ionization of helium to the n = 2 state was studied between 100 and 200 eV, at angles $\theta = 54°44'$ and $\theta = 90°$ between photon and photoelectron. The cross-section ratio $(\sigma_{2s} + \sigma_{2p})/\sigma_{1s}$ agrees well with the theoretical prediction by Jacobs and Burke; also the theoretical values of σ_{1s}/σ_{2p} and asymmetry parameter β_{2p} are consistent with experimental data. (auth)

57163 INTERACTION OF LASER LIGHT WITH THE 2^1S_0 METASTABLE STATE OF HELIUM. Jacobs, V. L.; Mizuno, J. (Queen's Univ. of Belfast). J. Phys., B (London); 5: No. 6, 1155-9(Jun 1972).

The cross sections for singly stimulated two-photon emission and anti-Stokes Raman scattering from the 2^1S_0 metastable state of helium are calculated by a variational procedure for incident photon wavelengths in the range from 5000 Å to 50 μm. (auth)

57164 HARTREE–FOCK CALCULATIONS FOR THE $4d^95s^25p^64f$ CONFIGURATION IN La IV. Hansen, J. E. (Lund Inst. of Tech., Sweden). J. Phys., B (London); 5: No. 6, 1096-1100(Jun 1972).

Recently discrete resonances in the photoabsorption spectrum of La near the 4d electron threshold have been identified as combinations between the ground state of La IV, $4d^{10}5s^25p^6\ {}^1S_0$, and the J = 1 levels of the $4d^95s^25p^64f$ configuration, the strongest combination being with $4d^94f\,{}^1P_1$. The agreement was satisfactory between energies from observations and from ab initio calculations except for $^1P_1$, for which the energy predicted by using wave functions determined for the mean energy of the whole configuration is about 14 eV too high. The present Hartree–Fock calculation for the ^1P term removes half of this discrepancy. Part of the remaining discrepancy may be caused by solid state effects. The relevance of this result for calculations of photoionization in Ar I and Xe I is pointed out. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstracts 57171, 57225, 57226, 57287, 57931, 57963, and 57977.

57165 THEORETICAL INTERPRETATION OF THE QUADRATIC HYPERFINE PRESSURE SHIFT. Ray, S.; Kaufman, S. L. (Univ., Heidelberg). Phys. Rev. Lett.; 29: No. 14, 895-8(2 Oct 1972).

The quadratic term in the hyperfine pressure shift, recently observed for alkali metals and muonium in noble gas atmospheres, is interpreted in terms of the interaction between three atoms. Approximate calculations show that short-range contributions predominate, even for heavy atoms. The results of the theoretical estimate are in reasonable agreement with the experimentally observed values in view of the approximations used. (auth)

Collision Phenomena

Refer also to abstracts 57145 and 57485.

57166 (COO–3381-11) INTERACTION OF RADIATION WITH MATTER. Progress Research Report, February 1, 1971–August 31, 1972. (New York Univ., N. Y. Radiation and Solid State Lab.). Apr 1972. 100p. Dep. NTIS.

Progress during the period on the following projects in the field of heavy ion physics is summarized: projectile charge dependence of K-shell ionization, cross sections for inner-shell excitations in atom–atom collisions, Coulomb and Pauli excitation in atomic collisions, binding and Coulomb-corrected cross sections for L-shell ionization by heavy charged particles, radiative transitions between quasi-molecular levels during energetic atom–atom collisions, low-energy stopping powers of compounds, beam–foil spectroscopy, computer simulation of particle channeling in crystals, dechanneling of charged particles in crystals, universal nature of the atomic photoabsorption cross sections, analysis of electron micrographs of extended DNA molecules, and photon-excited paramagnetic states in positron research. Some illustrative data, lists of publications, and an outline of future programs are included. Experimental and theoretical work on energy transfer processes involved in absorption of radiation by organic solids and liquids is summarized more briefly. (A.G.W.)

57167 VARIATIONAL FORMULATION OF THE EFFECTIVE POTENTIAL. Monaghan, William. New York; New York Univ. (1972). 93p. University Microfilms Order No. 72-21,523. Thesis.

This thesis concerns itself with the study of an effective potential formalism for the three-body problem. The formulation is within the context of an integral equation approach to the problem and is therefore distinct from the projection-operator formalism of Feshbach. If the energy of the system is restricted so that only one channel is opened, the three-body problem is reduced to one of two bodies with an effective potential. The effective potential contains all of the three-body aspects of the problem. While the effective potential formally solves the problem the construction of such a potential may be as difficult as the original three-body problem. A procedure for obtaining variational bounds on the effective potential is presented. If one invokes a monotonicity theorem which relates infinitesimal changes in the effective potential to changes in the phase shifts, the above bounds on the effective potential will generate bounds on the phase shift. Upper and lower bounds for the L = O phase shift were calculated for the single-channel elastic scattering of positrons off hydrogen. The extension of single-channel positron–hydrogen scattering to single channel positron–atom scattering is also presented. The positron–atom system presents the additional complication of having a many-body target. A technique was formulated which allows one to analyze this problem. At all intermediate stages of the analysis a minimum principle will be available which can be used to improve the intermediate calculations. The work of Faddeev is then used to formulate the effective potential for the many-channel three-body process. An analysis of the two-channel positron–hydrogen process motivated the functional form of the trial function used in the single-channel case. (Diss. Abstr. Int., B)

57168 IONIZATION OF ATOMS AND MOLECULES BY ELECTRON IMPACT: ENERGY LOSSES AND MOMENTUM TRANSFER. Sumin, L. V.; Gur'ev, M. V. (All-Union Inst. of Mineral Resources, Moscow). Zh. Eksp. Teor. Fiz.; 62: No. 6, 2026-35(Jun 1972). (In Russian).

Momentum transfer to ions in collisions between electrons and atoms is investigated. The mean projection of the ion momentum $\overline{P}_y$ onto the direction of the ionizing-electron momentum vector is measured. The magnitude of $\overline{P}_y$ depends on the angular and energy distribution of the ejected and scattered electrons and is related to the major collision characteristics. At low ionizing-electron energies the mean projection of the ion momentum characterizes the anisotropy of the secondary-electron angular distribution. At high electron energies (in the Born approximation) the magnitude of $\overline{P}_y$ for both the ion and excited atom is proportional to the mean energy loss of the incident electron. Data for He, Ne, Ar, Kr, H_2, N_2, CO_2, and H_2O are obtained for electron energies varying between 30 and 600 eV. (auth)

57169 RESONANCE STRUCTURE IN THE THRESHOLD ELECTRON IMPACT SPECTRUM OF CARBON MONOXIDE. Brion, C. E.; Olsen, L. A. R. (Univ. of British Columbia, Vancouver). Chem. Phys. Lett.; 15: No. 3, 442-4(15 Aug 1972).

The threshold electron-impact spectrum of CO is obtained using the sulfur hexafluoride electron-scavenging technique. Structure at 10 eV is correlated with the resonance recently observed in electron transmission and scattering studies of CO. (auth)

57170 CALCULATION OF THE COLLISION CROSS SECTIONS FOR SLOW EXCITED ATOMS AND MOLECULES. Kudrin L. P.; Mikhailova, Yu. V. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 63: No. 1, 63-74(Jul 1972). (In Russian).

The dependence of the elastic cross section, excitation-transfer cross section, and diffusion cross section on resonance defect is calculated. The difficulties that arise as a result of restricted applicability of the quasi-classical description of motion prescribed by a set of two second-order differential equations are elucidated. It is shown that the well-known Stukelberg result for the excitation-transfer cross section is correct only for sufficiently large resonance defects. (auth)

57171 CALCULATION OF THE $p\mu + He^{++}$ REACTION. Matveenko, A. V.; Ponomarev, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 63: No. 1, 48-52(Jul 1972). (In Russian).

The cross sections for μ^- meson capture by helium-isotope nuclei from the ground state of $p\mu$ and $d\mu$ mesic atoms are calculated. The calculation results are compared with theoretical and experimental estimates. The perturbed-stationary-state method is employed in the calculations. (auth)

57172 EVIDENCE FOR RADIATIVE ELECTRON CAPTURE BY FAST, HIGHLY STRIPPED HEAVY IONS. Schnopper, H. W. (Massachusetts Inst. of Tech., Cambridge); Betz, Hans D.; Delvaille, J. P.; (and others). Phys. Rev. Lett.; 29: No. 14, 898-901(2 Oct 1972).

The first observations of unusually energetic x rays from fast heavy-ion collisions in which the projectile ion captures a free or weakly bound target electron are reported. Energy calculations based on this model of radiative electron capture are in reasonably good agreement with the observed x-ray data. The phenomenon has been observed for 10- to 140-MeV sulfur, chlorine, and bromine ions incident on various targets from boron to uranium. (auth)

57173 ANGULAR DISTRIBUTION OF ELECTRONS AUTODETACHED FROM H^- IN SLOW COLLISIONS WITH He. Risley, J. S.; Edwards, A. K.; Geballe, R. (Univ. of Washington, Seattle). Phys. Rev. Lett.; 29: No. 14, 904-7(2 Oct 1972).

Angular distributions of electrons emitted by autodetachment of the first excited ^1S state of H^- produced in collisions of H^- on He exhibit an asymmetric shape peaked in the forward direction. (auth)

57174 APPLICATION OF THE HARRIS–NESBET METHOD TO A DIPOLE COUPLING POTENTIAL. Smith, E. R.; Oberoi, R. S.; Henry, Ronald J. W. (Louisiana State Univ., Baton Rouge). J. Comput. Phys.; 10: No. 1, 53-64(Aug 1972).

Elastic and inelastic cross sections for a two-channel model problem, in which dipole coupling is assumed, are calculated in the Harris–Nesbet method and compared with direct solutions of the Schroedinger equation. Two different coupling potentials are considered, one of which permits exact solution in terms of known functions, while the other requires a numerical solution. Results accurate to 1% are obtained for a nondegenerate case when a minimum representation for the wave function is taken as a combination of Slater orbitals and spherical Bessel and Neumann functions. For a degenerate case, it is found to be necessary to use sinusoidal energy-dependent terms in addition to Slater orbitals for a description of the internal part of the wave function and that, for the external part, only the leading asymptotic term of the spherical Bessel and Neumann functions need be retained. (auth)

57175 ELECTRONIC EXCITATION OF N_2 AND DISSOCIATIVE EXCITATION OF O_2 BY PROTON IMPACT. Moore, John H. Jr. (Univ. of Maryland, College Park). J. Geophys. Res.; 77: No. 28, 5567-72(1 Oct 1972).

The technique of energy-loss spectroscopy was applied to a study of inelastic noncharge exchange collisions between protons and molecular nitrogen and oxygen at energies of 0.6 to 4.0 keV. The most prominent proton-impact excitation process in N_2 is the Lyman–Birge–Hopfield (LBH) transition ($a^1\Pi_g \leftarrow X^1\Sigma_g^+$), for which the cross section increases from 0.55 to 3.0×10^{-17} cm^2 over the observed collision energy range. In O_2, dissociation results from excitation into the continuums associated with the upper states of the Schumann–Runge ($B^3\Sigma_u^- \leftarrow X^3\Sigma_g^-$) and Herzberg ($A^3\Sigma_u^+ \leftarrow X^3\Sigma_g^-$ or $C^3\Delta_u \leftarrow X^3\Sigma_g^-$) transitions. The total cross section for dissociative excitation of O_2 increases from 1.0 to 2.6×10^{-17} cm^2. (auth)

57176 DETERMINATION OF THE ELECTRON COLLISION CROSS SECTIONS FOR MOMENTUM TRANSFER OF ARGON AND POTASSIUM BY MEASURING THE DC CONDUCTIVITY OF A HIGH PRESSURE PLASMA. Beynon, J. D. E.; Brooker, P. G. (Univ. of Southampton, Eng.). J. Phys., B (London); 5: No. 4, 849-59(Apr 1972).

Argon at approximately atmospheric pressure is "seeded" with small amounts of potassium vapor and heated to about 1300°K in a specially designed furnace. The dc conductivity of the thermally produced plasma is measured by means of two electrodes whose separation is variable and one of which is equipped with a guard ring. By measuring the dc conductivity of the plasma over a wide range of potassium pressures, the cross sections for momentum transfer of argon and potassium were measured much more accurately than hitherto. The result obtained for argon $(2.24 \pm 0.13) \times 10^{-21}$ m^2 at 0.17 eV is different from previous experimental determinations but is in good agreement with the theoretical predictions of Frost and Phelps (Phys. Rev., 151: 48-51(1966)). The result for potassium, $(2.66 \pm 0.11) \times 10^{-18}$ m^2, is comparable to the results of other workers. (auth)

57177 PROTON PRODUCTION IN COLLISIONS BETWEEN ELECTRONS AND H_2^+ IONS. Rundel, R. D. (Rice Univ., Houston, Tex.). J. Phys., B (London); 5: No. 4, L76-8(Apr 1972).

Experimental and theoretical determinations of the cross section for proton production in $e-H_2^+$ collisions are surveyed. The reliability of the various experimental data is discussed as well as the extent to which theory and experiment are in agreement. (auth)

57178 GLAUBER CALCULATION OF ELECTRON–HYDROGEN IONIZATION CROSS SECTIONS. Hidalgo, M. B.; McGuire, J. H.; Doolen, G. D. (Texas A and M Univ., College Station). J. Phys., B (London); 5: No. 4, L70-2(Apr 1972).

Double differential cross sections, $d^2\sigma/dKdq$, for the ionization of hydrogen by electron impact were computed in the Glauber approximation. The Glauber cross section for large momentum transfer differs from the simpler Coulomb–Born results. (auth)

57179 DISSOCIATIVE ATTACHMENT AND A RESONANCE NEAR AN EXCITATION THRESHOLD. Chapman, C. J.; Herzenberg, A. (Yale Univ., New Haven). J. Phys., B (London); 5: No. 4, 790-809(Apr 1972).

Two similar theories of dissociative attachment have recently been criticized for giving an incomplete treatment of a crossing of the potential curves of a negative ion and a neutral molecule. (At such a crossing, an electronic resonance moves past an excitation threshold.) In particular, some authors have suggested that nonadiabatic effects are crucial at such a crossing. A crossing is analyzed in a model sufficiently simple for the energy curves to be calculated. It is shown that nonadiabatic effects are not important in the model and that the curve crossing has no connection with the Landau–Zener problem. The conclusion is that no modification of the original theories is needed to meet the criticisms. (auth)

57180 COLLISIONS BETWEEN ELECTRONS AND H_2^+ IONS. II. MEASUREMENTS OF CROSS SECTIONS FOR DISSOCIATIVE EXCITATION. Peart, B.; Dolder, K. T. (Univ. of Newcastle upon Tyne, Eng.). J. Phys., B (London); 5: No. 4, 860-5(Apr 1972).

Cross sections for the dissociative excitation of H_2^+ by electrons were measured for interaction energies between 25.4 and 715 eV. A source was used which produced H_2^+ ions under clearly defined conditions. Over the whole energy range, the measurements agree very closely with values obtained by averaging the theoretical cross sections of Peek in 1967 and Peek and Green in 1969 over a vibrational population given by Franck–Condon factors between hydrogen and H_2^+. (auth)

57181 CHANNEL COUPLING AND ATOMIC POLARIZATION IN ELECTRON COLLISIONS WITH MERCURY ATOMS. Mohr, C. B. O. (Univ. of Melbourne). J. Phys., B (London); 5: No. 4, 825-31(Apr 1972).

In calculating the elastic scattering of slow electrons by heavy atoms like mercury, there are the complicating effects of relativity, electron exchange, virtual transitions, and correlations; the first two have already been considered in detail by other workers. In this paper the effect of virtual transitions alone is considered, to see whether the use of either a polarization potential or the channel-coupling method provides a satisfactory treatment. It appears that these methods overestimate the effects at low energies and that more sophisticated methods, which are available but which require very lengthy calculations, are necessary to improve the existing calculations for mercury. (auth)

57182 ANALYTIC INTEGRALS FOR COLLISION THEORY. Tweed, R. J. (University Coll., London). J. Phys., B (London); 5: No. 4, 820-4(Apr 1972).

Analytic methods are used to evaluate certain integrals that occur in the determination of cross sections for electron-impact ionization. A considerable increase in both speed and accuracy is obtained over the more usual numerical methods. (auth)

57183 DOUBLE SCATTERING OF FAST PARTICLES. II. Vedrinskii, R. V.; Sharko, I. E. (Rostov State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 29-33(1971). (In Russian).

The problem concerning the form of the shadows in the angular distributions of particles scattered by weakly bound atoms is resolved. The scattering referred to is the result of subsequent scattering by neighboring atoms. The formulas developed relate to inelastic collisions of fast particles with atoms. (K.S.W.)

57184 EXCITATION IN FAST He–He COLLISIONS: THE INFLUENCE OF METASTABLE ATOMS. Gilbody, H. B.; Blair, W. G. F.; Simpson, F. R.; McCullough, R. W. (Queen's Univ., Belfast). J. Phys., B (London); 5: No. 5, L101-3(May 1972).

Excitation in collisions involving the passage of 70-keV He atoms through thin targets of helium was studied by a spectroscopic analysis of the spontaneous decay of the 4^1S, 4^1D, 4^3S, and 4^3D excited products of single collisions. A Doppler-shift separation of target and projectile emissions was possible. The 4^3S and 4^3D projectile and target emissions are shown to be strongly dependent on the metastable population of the beam. (auth)

57185 NOTE ON THE OFF-SHELL COULOMB T MATRIX. II. ELASTIC e–H DIFFERENTIAL CROSS SECTIONS. Hutton, N. A.; Roberts, M. J. (Univ. of Stirling, Eng.). J. Phys., B (London); 5: No. 5, L104-6(May 1972).

A form of the Coulomb T matrix, described in a previous note, is used in the first-order Faddeev–Watson approximation to evaluate e–H elastic differential cross sections at 200 eV incident-electron energy. The results confirm the large discrepancy with the Born approximation found by Chen and Sinfailam using a similar approximation. Modifications to the form of the T matrix near its energy shell are discussed, and it is shown how these can significantly alter the order of magnitude of the differential cross sections. (auth)

57186 DEDUCTION OF CLASSICAL BINARY ENCOUNTER APPROXIMATION FROM BORN APPROXIMATION. Bates, D. R.; McDonough, W. R. (Queen's Univ. of Belfast). J. Phys., B (London); 5: No. 5, L107-9(May 1972).

The key formula of the classical binary encounter approximation is derived from the Born approximation for the differential cross section for a general inelastic collision. (auth)

57187 COLLISION-RADIATION-COLLISION THREE-STEP PROCESSES, AND A MEASUREMENT OF THE PROBABILITY RATIO FOR NEUTRALIZATION OF 4-keV PROTONS INTO EITHER H(2p) OR H(1s). Durup, J.; Appell, J.; Fehsenfeld, F. C.; Fournier, P. (Paris Univ., Orsay, France). J. Phys., B (London); 5: No. 5, L110-14(May 1972).

Branching ratios for production of either H(2p) or H(1s) by neutralization of 4-keV protons on He, Ne, Ar, and H_2 were measured by double charge transfer $(H^+ \rightarrow H^-)$ translational spectroscopy. (auth)

57188 QUANTUM THEORY OF STARK BROADENING BY ELECTRONS. Tran-Minh, N.; Van Regemorter, H. (Observatoire de Paris, Meudon, France). J. Phys., B (London); 5: No. 5, 903-11(May 1972).

The one-electron approximation is used to determine the exact form of the wings of a line broadened by electron–atom collisions. The validity of this model is examined. The profile being proportional to the square of the scalar product of scattered waves, the impact approximation is obtained by replacing the exact form of the scattered waves by their asymptotic form. In the case of hydrogen the quasi-static approximation is obtained by using the JWKB method together with the usual assumptions. (auth)

57189 KOHN VARIATIONAL PRINCIPLE FOR THREE-BODY BREAKUP PROCESSES. Bryce, W. M.; Mandl, F. (Univ. of Manchester, Eng.). J. Phys., B (London); 5: No. 5, 912-20(May 1972).

A Kohn variational principle for the breakup process of a bound pair of particles colliding with a third particle is derived. Recently Lieber et al. have derived such a variational principle avoiding the difficulty that the asymptotic form of the time reversed final state (in which three particles are incident) is not fully known. Their proof involves divergent integrals which they handle by a process that is the analog for integrals of Cesàro summation. The present derivation also uses the methods of Lieber et al. to overcome the first difficulty but it avoids the need for the Cesàro summation procedure. This is achieved by going from complex to real energies only at a later stage in the derivation than is done by Lieber et al. The respects in which the derivation of the variational principle is not rigorous are discussed carefully. (auth)

57190 POSITRON–HYDROGEN ELASTIC SCATTERING WITH INCLUSION OF LONG-RANGE EFFECTS VIA A PSEUDOSTATE EXPANSION. Fon, W. C.; Gallaher, D. F. (Univ. of Western Ontario, London). J. Phys., B (London); 5: No. 5, 943-9(May 1972).

A complete calculation of positron–hydrogen elastic scattering in a pseudostate expansion formulation is made and results are obtained for s, p, d, etc. partial-wave phase shifts. Good agreement is found between these calculations and those of long-range-force-oriented models for energies below the positronium formation threshold. (auth)

57191 ELASTIC AND INELASTIC SCATTERING IN THE Li^+ + He SYSTEM. Lorents, D. C.; Conklin, G. M. (Stanford Research Inst., Menlo Park, Calif.). J. Phys., B (London); 5: No. 5, 950-62(May 1972).

Experimental studies of the Li^+ + He interaction were extended to smaller internuclear separations to clarify a discrepancy between experiment and theory in the elastic cross sections and to observe and measure cross sections for inelastic excitation. For $R \le 0.5a_0$ the elastic scattering differential cross section is observed to drop far below that expected from a single-state interaction based on ab initio ground-state potentials. In this same region of R both one- and two-electron excitations of He are observed to be strongly excited, and cross sections were measured for each of them. The lowest inelastic channel is an electron-capture state, which is observed indirectly to be strongly populated also. A diabatic correlation diagram is constructed that exhibits the basic interactions responsible for the excitation. (auth)

57192 ELASTIC AND INELASTIC SCATTERING OF Li^+ IONS BY He. Francois, R.; Dhuicq, D.; Barat, M. (Paris Univ., Orsay, France). J. Phys., B (London); 5: No. 5, 963-72(May 1972).

Elastic and inelastic differential measurements of the Li^+–He system were undertaken with particular attention given to the charge-exchange channels. The energy variation of the "summed" differential cross sections (elastic, inelastic, and charge exchange) agrees quite well with the published ab initio ground-state calculation, showing that most important channels are considered. The elastic and inelastic measurements are in good agreement with those of Lorentz and Conklin (Proc. 7th Int. Conf. Physics of Electronic and Atomic Collisions pp 130-2(1972)). All the inelastic and charge-exchange processes are discussed in the frame of the diabatic correlation diagram. (auth)

57193 ELASTIC AND INELASTIC SCATTERING IN Li^+–He COLLISIONS. McCarroll, R.; Piacentini, R. D. (Observatoire de Paris, Meudon, France). J. Phys., B (London); 5: No. 5, 973-8(May 1972).

Low-energy collisions between Li^+ and He are investigated using a molecular expansion that takes account of rotational coupling between the $^1\Sigma$, $^1\Pi$ and $^1\Delta$ states of the $LiHe^+$ quasi-molecule. Differential cross sections for elastic scattering and for excitation of those states formed by dissociation of the $^1\Pi$ and $^1\Delta$ states were computed for incident ion energies of 1.0, 1.5, and 2.0 keV and for a range of scattering angle from 0 to 35° (center-of-mass system). The agreement with experiment is satisfactory. It is shown that rotational coupling is an important excitation mechanism in Li^+–He collisions. (auth)

57194 IONIZATION OF HELIUM BY PROTON IMPACT. Salin, A. (Bordeaux Univ., Talence, France). J. Phys., B (London); 5: No. 5, 979-86(May 1972).

The calculation of cross sections differential in angle and ejection energy for electron production from helium by proton impact is discussed. The existence of a peak in these cross sections for electron velocities close to that of the incident proton is shown to be accurately predicted by the theory when the asymptotic conditions on the final wave function are established correctly. The ejection of electrons in the direction opposed to that of the proton is linked with the electron correlations in the initial state of the helium atom. (auth)

57195 CLASSICAL CALCULATION OF e–H COLLISIONS IONIZATION THRESHOLD LAW. Grujic, P. (Inst. of Physics, Belgrade). J. Phys., B (London); 5: No. 7, L137-9(Jul 1972).

Threshold behavior of the ionization interval function for electron–hydrogen-atom scattering was examined numerically, using a classical three-body computer program. Results confirm earlier calculations and are in accordance with Wannier's theory. (auth)

57196 ELECTRON EXCITATION CROSS SECTIONS FOR Si XII. Kastner, S. (Goddard Space Flight Center, Greenbelt, Md.); Smith, T. S.; Wade, C.; Blaha, M. J. Phys., B (London); 5: No. 7, 1351-8(Jul 1972).

Excitation cross sections are calculated for Si XII by the Coulomb–Born method, using numerical Hartree–Fock radial functions. The transitions considered are 2s–np, ns–n′d, 2p–nd, and 3s–np. Reasonable agreement with the general results of Bely and Petrini is obtained, but an appreciable difference occurs for 2s–7p. The effect of including higher multipoles in the Coulomb–Born method is illustrated. For comparison, the plane-wave Born approximation is also used to obtain cross sections for the 2s–np transitions, as well as for 2s–ns and 2s–nd, and is found to approach the correct result to within a factor of three for incident energies greater than three times the threshold value. (auth)

57197 EFFECT OF DIPOLE MOMENT ON THE COLLISION-INDUCED DISSOCIATION OF HD^+ ION BY ELECTRON IMPACT. Saha, S.; Mullick, K.; Barua, A. K. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., B (London); 5: No. 7, 1369-80(Jul 1972).

The effects of the dipole moment of HD^+ ion on the differential and total cross section for the collision-induced dissociation of HD^+ ion by electron impact were analyzed quantitatively. For this purpose the Born–Oppenheimer approximation was used and the electron–dipole interaction term was included in the hamiltonian for exchange scattering amplitude. Some very interesting features in the differential and total cross sections for dissociation are predicted, which are due to the heteronuclearity and the dipole moment of the molecular ion. (auth)

57198 DISTORTION POLARIZATION OF ORBITALS AND THE ASYMMETRY IN THE FORWARD-BACKWARD SCATTERING OF FRAGMENTS FROM DISSOCIATION OF $(HeH)^+$ ION. Mullick, K.; Roy, C. S.; Barua, A. K. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., B (London); 5: No. 7, 1381-5 (Jul 1972).

The possibility of explanation of the observed asymmetry in the forward–backward scattering of He^+ fragments produced from the collision-induced dissociation by electron impact of $(HeH)^+$ ion, in terms of the distortion polarization of the orbitals, is examined. The results indicate that this factor cannot account for the observed effect. (auth)

57199 ELECTRON CAPTURE BY METASTABLE HYDROGEN Dose, V.; Gunz, R. (Univ., Zurich). J. Phys., B (London); 5: No. 7, 1412-16(Jul 1972).

Cross sections for electron capture by H(2s) in collisions with argon, nitrogen, and oxygen were measured in the energy range 1.4 to 8 keV. At 1.4 keV the capture cross section is as large as 2×10^{-15} cm^2 for argon and roughly an order of magnitude smaller for oxygen and nitrogen. In all three cases the cross section for capture by metastables decreases rapidly as a function of energy and approaches the cross section for electron capture by ground-state hydrogen at the high-energy end of the range. Using earlier measurements on electron loss from metastable hydrogen (Dose and Gunz 1971) a lower bound to the total destruction cross section is established. (auth)

57200 LOW-ENERGY SCATTERING BY THE r^{-3} POTENTIAL. Shakeshaft, R. (Univ. of Nebraska, Lincoln). J. Phys., B (London); 5: No. 6, L115-17(Jun 1972).

The two-potential formula of scattering theory is used to determine the low-energy scattering by long-range potentials having the asymptotic form r^{-3}. An interaction of this form occurs between two identical neutral atoms excited to different degrees. Tan δ_0 is calculated up to and including the k^4 term and, for $L > 0$, tan δ_L is calculated up to and including the k^{2L+1} term. (auth)

57201 VARIATION WITH ELECTRON SCATTERING ANGLE OF THE POLARIZATION OF ATOMIC LINE RADIATION EXCITED BY ELECTRON IMPACT. Wykes, J. (Univ. of Edinburgh). J. Phys., B (London); 5: No. 6, 1126-37(Jun 1972).

Information on both the relative magnitudes and phases of the various scattering amplitudes can be obtained by measuring the angular correlation of inelastically scattered electrons with the emitted photons in the electron-impact excitation of atomic line radiation. As an example, excitation of sodium resonance radiation by electron impact at energies close to threshold is examined using close coupling T matrices of Karule and Peterkop. (auth)

57202 IONIZATION OF BORON AND THE ISOELECTRONIC IONS CARBON II, NITROGEN III, AND OXYGEN IV BY ELECTRON IMPACT. Stingl, E. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). J. Phys., B (London); 5: No. 6, 1160-74 (Jun 1972).

Electron-impact ionization of boron, carbon II, nitrogen III, and oxygen IV in their ground-state configuration $1s^22s^22p$ is treated, where allowance is made for inner-shell ionization. Partial-wave cross sections were calculated using both the so-called "modified" Coulomb–Born and the Coulomb–Born exchange approximation. Comparison is made with the only existing results of Peach and Lotz. (auth)

57203 LOW ENERGY ($\leq$1 eV) ELECTRON ATTACHMENT TO MOLECULES AT VERY HIGH GAS DENSITIES: O_2. McCorkle, D. L.; Christophorous, L. G.; Anderson, V. E. (Oak Ridge National Lab., Tenn.). J. Phys., B (London); 5: No. 6, 1211-20(Jun 1972).

Drastic changes are observed in both the magnitude and the energy dependence of the attachment cross section, $\sigma_a(\epsilon)$, for the formation of O_2^- with increasing N_2 density in O_2–N_2 mixtures. At low densities $\sigma_a(\epsilon)$ exhibits distinct structure attributed to electron capture into vibrational states of O_2^-. (auth)

Atomic Theory

Refer also to abstracts 57158, 57985, 57998, 58004, 58006, 58007, and 58009.

57204 CORRELATED WAVEFUNCTIONS FOR HELIUM-LIKE ATOMIC SYSTEMS. Tweed, R. J. (University Coll., London). J. Phys., B (London); 5: No. 4, 810-19(Apr 1972).

Wave functions are calculated for helium-like atomic systems, taking fully into account the "correlation" term of the Hamiltonian. They are in a form that is easily separable into a sum of products of one-electron functions. (auth)

57205 FORMULA FOR RELATIVISTIC ATOMIC ENERGIES. II. Snyder, R. (Queen's Univ., Belfast). J. Phys., B (London); 5: No. 5, 934-42(May 1972).

A formula previously given for relativistic atomic energies is used to calculate fine-structure splittings in the remaining $1s^22s^a2p^b$ cases. Relativistic corrections to the LS configuration averages are also discussed. The accuracy is comparable to that of the best Hartree–Fock calculations. Some of the results and discussion are relevant to any theoretical method that involves jj configuration averages. (auth)

57206 APPROXIMATIONS EMPLOYED IN SPONTANEOUS EMISSION THEORY. Walls, D. F.; Gardiner, C. W. (Univ. of Waikato, Hamilton, N. Z.). Phys. Lett.; 41A: No. 2, 121-2(11 Sep 1972).

It is shown that the Wigner–Weisskopf, rotating-wave, and ladder approximations used in spontaneous emission theory are closely related. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

57207 EXACT SOLUTION OF AN EQUATION OF UNSTEADY MOTION OF A CONDUCTING FLUID WITH ACCOUNT OF JOULE HEAT. Sharikadze, D. V.; Megakhed, A. A. (Tbilissi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 67: No. 3, 589-92(Sep 1972). (In Russian).

Heat transfer in an incompressible MHD boundary layer on a porous plate has been studied. A solution of the energy equation, including Joule losses, is obtained by introducing $E = CT + u^2/2$ and writing the exact solution for E. (auth)

57208 ON MAGNETOHYDRODYNAMIC FLOW AT LOW AND MODERATE HARTMANN NUMBERS. Roach, J. P.; Fahidy, T. Z. (Univ. of Waterloo, Ont.). Can. J. Chem. Eng.; 50: No. 3, 414-8(Jun 1972).

Two-dimensional magnetohydrodynamic flows were studied in the configuration consisting of conducting walls parallel to the imposed magnetic field and insulating walls perpendicular to the field. The analytical treatment of the induced magnetic field and fluid velocity distributions is made difficult by the boundary conditions of the pertinent MHD-system equations. The rigorous solution proposed by Grinberg in terms of Green's functions, valid for any arbitrary Hartmann number, was applied using a computation procedure developed for high-speed digital devices. The Grinberg solution permits accurate treatment of problems well below a Hartmann number of 15, using the computation scheme proposed. (E.M.T.) (Canada)

57209 UPPER BOUND OF LONGITUDINAL WAVE FREQUENCY IN MHD FLUID. Bondopadhaya, R. (Jadavpur Univ., Calcutta). Indian J. Phys.; 45: No. 12, 550-2(Dec 1971).

An expression for the upper bound of the frequency ω_c of any longitudinal MHD wave propagating with the frequency ω through a medium consisting of fully ionized hydrogen is obtained such that $\omega \ll \omega_c$. The numerical value of ω_c is calculated for the solar atmosphere. (auth)

57210 SLOW MHD FLOW BETWEEN TWO NONPARALLEL PLATES. Soundalgekar, V. M.; Haldavnekar, D. D. Stud. Univ. Babes-Bolyai, Ser. Phys.; 17: No. 1, 47-51(1972).

The effect of the magnetic field on the slow motion of an electrically conducting, incompressible, viscous fluid between two nonparallel plates is discussed. Series solutions are obtained for small values of R, the Reynolds number, and velocity profiles are shown in case of both convergent and divergent flows for different values of the Hartmann number. The velocity profiles are observed to be positive at small R in the presence of the magnetic field. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 56806.

57211 MISSING MOMENTUM ANALYSIS AS A TOOL TO INVESTIGATE THE PRODUCTION OF NEUTRAL PARTICLES. Caneschi, L. (CERN, Geneva); de Groot, E. H.; Schwimmer, A. Nucl. Phys.; B47: No. 1, 19-28(1972).

The study of the distribution of the missing momentum in experiments in which only (but all) charged particles are detected is proposed as a useful tool to investigate the properties of the production of neutral particles. (auth)

Electromagnetic

Refer also to abstracts 56250, 56251, and 56848.

57212 (CLNS–189) PI-ZERO PHOTOPRODUCTION FROM NEUTRONS. Osborne, A. M.; Browman, A.; Hanson, K.; Meyer, W. T.; Silverman, A.; Taylor, F. E. (Cornell Univ., Ithaca, N. Y. Lab. of Nuclear Studies); Horwitz, N. (Syracuse Univ., N. Y.). Jul 1972. 29p.

The ratio of the cross section for $\gamma + n \rightarrow \pi^0 + n$ to the cross section for $\gamma + p \rightarrow \pi^0 + p$ at 4.7 and 8.2 GeV was measured. The measurements were made by detecting the recoil nucleons in coincidence with the decay γ rays of the pi-zeros produced from a deuterium target. The cross section ratio, $R \equiv [\sigma(\gamma n \rightarrow \pi^0 n)/\sigma(\gamma p \rightarrow \pi^0 p)]$, is near 0.85 at small t, drops to 0.7 at $t = -0.7$ $(GeV/c)^2$, and then rises to about 1.0 at $t = -1.0$ $(GeV/c)^2$. (auth)

57213 (DESY–72/31) MEASUREMENTS OF INCLUSIVE HADRON MOMENTUM DISTRIBUTIONS IN DEEP INELASTIC ELECTROPRODUCTION. Alder, J. C.; Brasse, F. W.; Chazelas, E.; (and others) (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jun 1972. 26p. Dep. NTIS (U. S. Sales Only).

The distribution of hadrons in the direction of the virtual photon was investigated in the deep inelastic region of electron–proton scattering. Coincidence measurements between the scattered electron and proton, $\pi^{\pm}$, or $K^{\pm}$ were made at $q^2 = 1.16$ GeV^2 and $W = 2.63$ GeV. Momentum and missing mass distributions are presented. They are compared with other electroproduction measurements, with photoproduction, and with hadronic reactions. (10 figures, 1 table) (auth)

57214 (DNPL/P–135) PROTON COMPTON SCATTERING BETWEEN 650 MeV AND 1350 MeV. Barton, J. S.; Booth, P. S. L.; Carroll, L. J.; Holt, J. R.; Hufton, A. P.; Jackson, J. N.; Moscati, G.; Norem, J. H.; Wormald, J. R. (Daresbury Nuclear Physics Lab. (England)). Aug 1972. 12p. Dep. NTIS (U. S. Sales Only).

Compton scattering from protons was measured between 650 and 1350 MeV for angles between 60 and 140° cm. (auth)

57215 MEASUREMENT OF THE RATIO OF DOUBLE TO SINGLE ELECTRON–POSITRON PAIR-CREATION CROSS SECTIONS FOR 6.6-MeV PHOTONS. Robertson, A.; Prestwich, W. V.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Phys. Rev. Lett.; 29: No. 14, 966-9(2 Oct 1972).

An investigation of double electron–positron pair creation was conducted using a quadrisected annulus of NaI with γ rays of average energy 6.6 MeV impinging upon targets of copper, aluminum, carbon, and beryllium. The data, corrected for bremsstrahlung effects, were fitted by a linear function of atomic number in order to separate the instantaneous double-pair production process from the direct-cascade effect. The result of the measurement is given as $\sigma_{\pi\pi}/\sigma_{\pi} = (2.4 \pm 1.6) \times 10^{-5}$. (auth)

57216 MEASUREMENT OF RADIATIVE PION–PROTON SCATTERING NEAR THE $\Delta(1236)$ RESONANCE. Arman, M.; Blasberg, D. J.; Haddock, R. P.; (and others) (Univ. of California, Los Angeles). Phys. Rev. Lett.; 29: No. 14, 962-5(2 Oct 1972).

The differential cross section for radiative π^+-proton scattering, $\pi^+ p \rightarrow \pi^+ p\gamma$, was measured at 294 MeV under kinematical conditions favorable to the observation of radiation from the magnetic dipole moment of the $\Delta^{++}(1236)$ resonance. For radiated photon energies above 30 MeV, the data do not agree with explicit theoretical calculations which include an estimate of the magnetic moment radiation; rather, the data agree with the simple expression in the c. m. system, $d\sigma/d\tilde{\Omega}_\pi d\tilde{\Omega}_\gamma d\tilde{E}_\gamma = \sigma_0/\tilde{E}_\gamma$, over the full range of photon energy, up to $\tilde{E}_\gamma = 140$ MeV. Preliminary measurements of radiative π^-–proton scattering were also made. (auth)

57217 INCREASE OF TRANSVERSE MOMENTA IN NUCLEAR INTERACTIONS AT ENERGY $\geq 10^{12}$ eV FROM EAS DATA. Fomin, Yu. A.; Khristiansen, G. B. (Moscow State Univ.). Yadern. Fiz.; 15: No. 4, 757-62(Apr 1972). (In Russian).

An analysis of experimental data on the muon and nuclear active particles space distribution in extensive air showers was carried out. The experimental data are compared with theoretical calculations made on the basis of various models of the extended air shower development but with the assumption of $\bar{p}_\perp = 0.3$ to 0.4 GeV/c in all energy intervals. The comparison shows that to obtain consistency between theoretical calculations and experimental data it is necessary to assume an increase of the average transverse momenta up to 1.0 to 2.0 GeV/c from the energy 300 GeV. (auth)

57218 SEARCH FOR THE DECAY MODE $\omega \rightarrow \eta\gamma$ IN THE REACTION $\pi^- p \rightarrow n +$ NEUTRAL BOSON. Apel, W. D. (Univ., Karlsruhe, Ger.); Auslaender, J.; Mueller, H.; (and others). Phys. Lett.; 41B: No. 2, 234-6(18 Sep 1972).

A search was made for $\omega \rightarrow \eta\gamma$, $\eta \rightarrow 2\gamma$ decays in a sample of 1252 $\pi^- p \rightarrow 3\gamma + n$ events with the 3γ invariant mass in the ω-region. Practically all events fit $\omega \rightarrow \pi^0\gamma$, $\pi^0 \rightarrow 2\gamma$ and it is found that $(\omega \rightarrow \eta\gamma, \eta \rightarrow 2\gamma)/(\omega \rightarrow \pi^0\gamma, \pi^0 \rightarrow 2\gamma) = (0.4 \pm 1.7)\%$. (auth)

57219 OBSERVED DIFFERENCE IN THE RANGES OF POSITIVE AND NEGATIVE MUONS. Clark, A. R.; Field, R. C.; Frisch, H. J.; (and others) (Univ. of California, Berkeley). Phys. Lett.; 41B: No. 2, 229-33(18 Sep 1972).

The measured ranges of negative muons are ~0.2% greater than those of positive muons of the same initial momenta in the interval 500-1500 MeV/c. This necessitates a correction to published values for the CP-violating charge asymmetry in $K^\circ\mu3$ decays. (auth)

57220 AXIAL-VECTOR FORM-FACTOR OF THE NUCLEON FROM A COINCIDENCE EXPERIMENT ON ELECTROPRODUCTION AT THRESHOLD. Amaldi, E.; Benevantano, M.; Borgia, B.; (and others) (Univ., Rome). Phys. Lett.; 41B: No. 2, 216-20 (18 Sep 1972).

The electroproduction cross section of π^+ at threshold was measured by a coincidence experiment for a momentum transfer $|k^2| = 0.16 - 0.24$ $(GeV/c)^2$. From these data the isovector axial form factor G_A of the nucleon is derived. (auth)

57221 MEASUREMENT OF THE ELECTRON–POSITRON ANNIHILATION CROSS-SECTION INTO $\pi^+\pi^-$, K^+K^--PAIRS AT THE TOTAL ENERGY 1.18 TO 1.34 GeV. Balakin, V. E.; Budker, G. I.; Kurdadze, L. M.; (and others) (Inst. of Nuclear Physics, Novosibirsk, USSR). Phys. Lett.; 41B: No. 2, 205-8(18 Sep 1972).

Using the electron–positron storage ring VEPP-2 an experiment was performed in which the cross sections of the reactions $e^+e^- \rightarrow \pi^+\pi^-$ and $e^+e^- \rightarrow K^+K^-$ were measured in the energy region 1.18 to 1.34 GeV. The experimental values of the form factors lie higher than curves extrapolated from the ρ- and ϕ-meson region. (auth)

57222 ANALYSIS OF γp REACTIONS IN THE LPS FRAMEWORK AT $E_\gamma = 6$ TO 18 GeV. Liu, F. F.; Davier, M.; Derado, I.; (and others) (Stanford Univ., Calif.). Nucl. Phys.; B47: No. 1, 1-18(1972).

The reactions $\gamma p \rightarrow \pi^+\pi^- p$ and $\gamma p \rightarrow \pi^+\pi^-\pi^+\pi^- p$ in the energy range $E_\gamma = 6$ to 18 GeV from the SLAC 2m streamer chamber are analyzed in terms of the longitudinal-phase-space (LPS) method. The 3-body LPS hexagonal plots show accumulations which reflect the dominant diffractive ρ^0 production. The five-body final state is divided into sixteen LPS sectors. The partial cross sections, invariant-mass and momentum-transfer distributions of the four populous sectors are presented and discussed. Within this framework, an attempt is made to isolate and study the dissociations $\gamma \rightarrow \pi^+\pi^-$, $\gamma \rightarrow \pi^+\pi^-\pi^+\pi^-$ and the double dissociations $\gamma \rightarrow \pi^+\pi^-$, $p \rightarrow p\pi^+\pi^-$. The proton dissociation $p \rightarrow p\pi^+\pi^-$ is found to be in approximate agreement with results from πp and pp reactions. Assuming that pomeron exchange dominates, this result is consistent with pomeron factorization. (auth)

57223 NEW DETERMINATION OF THE PROTON MAGNETIC MOMENT IN TERMS OF NUCLEAR MAGNETONS WITH AN ERROR OF 4.3×10^{-5} PERCENT. Mamyurin, B. A.; Aruev, N. N.; Alekseenko, S. A. (Moscow Physical-Technical Inst.) Zh. Eksp. Teor. Fiz.; 63: No. 1, 3-20(Jul 1972). (In Russian).

A new technique for measuring the magnetic moment of the proton in terms of nuclear magnetons (μ_p/μ_n) is proposed in which use is made of a magnetic resonance mass-spectrometer with a special double-section ion source. The new technique almost completely removes the effect of stray electric fields on the results of measurement of the proton cyclotron frequency. This could not be achieved by employing any of the other methods. The proton spin precession frequency required for determining the value of μ_p/μ_n is measured with a nuclear-magnetic resonance proton detector located in the same magnetic field in which the proton cyclotron frequency is determined. A description of the measurement arrangement of the measuring technique is given. All sources of random and systematic errors are considered and assessed. A set of control experiments which confirm the estimates of the errors is described. Results of 11 measurement sets yielded a value of $\mu_p/\mu_n = 2.7927744 \pm 0.0000012$ ($4.3 \cdot 10^{-5}\%$) for the magnetic moment of the proton in nuclear magnetons (without a correction for diamagnetic screening of the protons in water). (auth)

Weak

Refer also to abstract 57323.

57224 (TID–26145) RESEARCH IN ELEMENTARY PARTICLE PHYSICS. Technical Progress Report. Kirsch, Lawrence; Schnitzer, Howard J. (Brandeis Univ., Waltham, Mass. Dept. of Physics). 29 May 1972. Contract AT(11-1)-3230. 10p. Dep. NTIS.

Research in the theoretical and experimental properties of elementary particles is briefly summarized. The production and decay properties of the Σ(1660) were studied. It was found that the Σ(1660) seen in production experiments decays primarily into Λ(1405)π, and displays little or no decay into any other channel; the differential cross section for this process shows a sharp decline away from the forward direction characteristic of two-body processes proceeding by one-particle exchange; the spin and parity of the production Σ(1660) were measured by using three independent techniques, and all favored a $J^P = \frac{3}{2}^-$ assignment. Anomalies of perturbation theory that give rise to the violation of scaling in the deep inelastic region were studied theoretically. Work combining current algebra and unitarity was continued, to study the issue of extrapolation in the pion mass in the evaluation of the σ term in πN scattering. Improvements in the capability of the PDP 15/20 are also discussed. (R.W.R.)

57225 DEPENDENCE OF NEGATIVE MUON DEPOLARIZATION ON MOLECULAR WEIGHT AND TEMPERATURE IN ORGANIC COMPOUNDS. Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 1, 114-20(Jul 1972). (In Russian).

An atomic capture of negative muons in the aliphatic spirit series, the dependence of muon rest polarization on the molecular weight of spirit, was studied. The temperature dependence of depolarization in benzole and styrene was obtained. The results on depolarization are being interpreted based on notions about chemical interactions of mesonic atoms in organic compounds. (auth)

57226 · NEGATIVE MUON DEPOLARIZATION IN MONOMERIC AND POLYMERIC ORGANIC COMPOUNDS. Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S.; Kholodov, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 1, 121-4(Jul 1972). (In Russian).

It is shown that in transition from monomer to polymeride the value of the rest polarization of negative muons decreases approximately by 1,4 times, if polymer chain does not contain any olefinic bound. If there are olefinic bounds (polyisoprene), the polarization is just the same as the one in monomer. These experimental data are interpreted on the basis of the model, that takes into account chemical reactions of mesonic atoms. (auth)

57227 EVIDENCE FOR DIRECT EMISSION IN THE DECAY $K^\pm \rightarrow \pi^\pm\pi^0\gamma$. Abrams, R. J.; Carroll, A. S.; Kycia, T. F.; (and others) (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett.; 29: No. 16, 1118-22(16 Oct 1972).

About 4000 events were obtained above background which satisfy the two-constraint fit with the hypothesis $K^\pm \rightarrow \pi^\pm\pi^0\gamma$. Their Dalitz-plot population shows the existence of direct radiation in addition to that of the expected inner bremsstrahlung. The best fit to the sum of K^+ and K^- decays in the charged-pion kinetic energy interval of 55 to 90 MeV gives a branching ratio for direct emission of $(1.56 \pm 0.35) \times 10^{-5}$, with a systematic uncertainty of $\pm 0.5 \times 10^{-5}$. No interference is required for a good fit. (auth)

57228 GENERATION AND INTERACTION OF MUONS WITH ENERGY $E_\mu \geq 10^{12}$ eV. Khristiansen, G. B.; Vedeneev, O. V.; Nechin, Yu. A. (Moscow State Univ.). Yadern. Fiz.; 15: No. 5, 966-74(May 1972). (In Russian).

The experimental data on the energy spectra of the vertical flow of muons with energy $E_\mu \geq 5 \times 10^{11}$ eV, and the cross sections for photonuclear interactions of such energy muons are given. The results were obtained by the "ionization burst" method at the earth depth of 40 m.w.e. The data confirm the conclusions, which were made in Moscow University earlier (1963), on the more rapid muon generation in collisions at $E_\mu > 10^{12}$ eV as compared with $\pi \rightarrow \mu$ and $K \rightarrow \mu$ decays, and on the increasing of the muon photonuclear interaction cross section at $E_\mu > 5 \times 10^{11}$ eV with increasing of their energy. The results of the other work are discussed which was published recently and confirm these conclusions. (auth)

57229 TRANSMISSION REGENERATION OF NEUTRAL K-MESONS ON HYDROGEN IN THE MOMENTUM REGION 14 TO 42 GeV/c. Birulev, V. K.; Vovenko, A. S.; Vestergombi, D.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 5, 959-65(May 1972). (In Russian).

The measurements of the amplitude of the K^0 transmission regeneration on hydrogen in the momentum region 14 to 42 GeV/c have shown that in accordance with the Pomeranchuk theorem requirements the quantity $|f^0 - \bar{f}^0|/k$ decreases with increasing of the energy, and the phase is approximately constant and equals $\arg(f^0 - \bar{f}^0) = -118 \pm 13°$. (26 references) (auth)

57230 DETERMINATION OF THE K_S DECAY BRANCHING RATIO. Nagy, E.; Telbisz, F.; Vesztergombi, G. (Central Research Inst. for Physics, Budapest). Nucl. Phys.; B47: No. 1, 94-8(1972).

The measurement of the ratio of rates $[R = \Gamma(K_S \rightarrow \pi^+\pi^-)/\Gamma(K_S \rightarrow \pi^0\pi^0)]$ was carried out by means of the Ecole Polytechnique 1 m heavy liquid bubble chamber irradiated by a 800-MeV/c K^+ beam. The result is a weighted average of two independent measurements corresponding to two different types of chamber liquid. The total number of observed $\pi^+\pi^-$ decays was 3000, and 701 $\pi^0\pi^0$ decays were registered. R turned out to be 2.10 ± 0.11. (auth)

Strong (Baryon-induced)

Refer also to abstracts 56843, 56844, 57336, 57366, 57546, and 57565.

57231 (CERN-72-10, pp 27-33) REPORT ON $\bar{p}p \rightarrow K\bar{K}$ AT LOW MOMENTUM. Benvenuti, A.; Cline, D.; Reeder, D. D.; Rutz, R. (Univ. of Wisconsin, Madison).

From Symposium on nucleon—antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

Some preliminary results are reported for the reaction $\bar{p}p \rightarrow K^+K^-$ at 300 to 800 MeV/c. The cross-section distribution for this reaction is presented and compared with the cross sections for the following reactions: $\bar{p}p \rightarrow K_S^0K_L^0$, $\bar{p}p \rightarrow K_S^0K_S^0 + K_L^0K_L^0$, and $\bar{p}n \rightarrow K^-K^0$. Under certain assumptions the structures observed in the cross section distribution are interpreted as due to a resonance with isospin zero interfering with a background with isospin one. (L.B.S.)

57232 (CERN–72-10, pp 35-66) FORMATION EXPERIMENT: T REGION. Bertanza, L. (Univ., Pisa, Italy).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

Summaries are presented of formation experiments performed in search for evidence of the T meson of mass about 2200 MeV and possibly to measure its quantum numbers. Cross sections for various annihilation channels of $\bar{p}p$ and $\bar{p}n$ interactions are presented. It is concluded that the situation in the T region, as it results from formation experiments, is not yet clarified, but some progress has been made. Indications are found for more than one resonance in the T region. (L.B.S.)

57233 (CERN-72-10, pp 67-71) DIRECT S-CHANNEL EFFECTS IN THE FINAL STATE $K_1^0K_1^0\omega^0$ IN THE REGION OF THE T-MESON.

From Symposium on nucleon—antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

A report is given on the analysis of the full statistics of the experiments on the $\bar{p}p \rightarrow K_1^0K_1^0\omega^0$ interactions from several exposures at 1.1 to 1.44 GeV/c in the CERN 200 cm chamber and one at 1.18 GeV/c in the Saclay 81 cm chamber. Cross sections for this reaction and for $\bar{p}p \rightarrow K_1^0K_1^0\pi^+\pi^-\pi^0$ are presented. A maximum likelihood fit was carried out at each energy range, allowing for both single and associated resonance production. It is concluded that no direct channel effect is necessary to explain the data. (L.B.S.)

57234 (CERN–72-10, pp 73-111) FORMATION EXPERIMENTS IN THE U-REGION. Astbury, A. (Rutherford Lab., Chilton, Eng.).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

Summaries are presented along with conclusions on various formation experiments on the $\bar{p}p$ interaction in the U-region. These include missing mass experiments; total cross section measurements; the elastic channel; the charge exchange channel $\bar{p}p \rightarrow \bar{n}n$; the channel $\bar{p}p \rightarrow \pi^+\pi^-$, K^+K^-; the $\bar{p}p \rightarrow \bar{K}K\pi\pi\pi$ channel. It is concluded that no evidence exists for a narrow state in the U region from formation experiments. (L.B.S.)

57235 (CERN-72-10, pp 227-8) SUMMARY OF THE ANALYSIS OF $\bar{p}p \rightarrow \omega\pi^+\pi^-$.

From Symposium on nucleon—antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

A summary of the analysis of 8000 events of stopped $\bar{p}$ leading to $\omega^0\pi^+\pi^-$ is presented, which includes the assumptions, techniques, and results. (L.B.S.)

57236 (CERN-72-10, pp 253-7) STATUS REPORT ON THE 2.3 GeV/c $\bar{p}p$ EXPERIMENT. Allison, W. W. M. (Oxford Univ.).

From Symposium on nucleon—antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

Angular distributions for elastic $\bar{p}p$ interactions and the reactions with final states K^-K^+, $\pi^-\pi^+$, $\rho^-\pi^+/\pi^-\varphi^+$, $\rho^0\pi$, and $f^0\pi$ are presented. Positive support is found for a dual picture of towers of resonances with strong degeneracies such that s and t channel descriptions are equivalent. (L.B.S.)

57237 (CERN-72-10, pp 301-18) WHAT HAVE WE LEARNED ON MESONS? Moebes, J. (CERN, Geneva).

From Symposium on nucleon—antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

Information obtained on meson resonances produced in $\bar{p}p$ annihilations is discussed under the following headings: (1) ω^0; (2) $K\bar{K}$ threshold effects: $\pi_N(1016)$, $S^*(1070)$; (3) "diffractive" mesons: A_1, B, C, and (4) $K\bar{K}\pi$ effects; D, E, F_1. (L.B.S.)

57238 (JINR–P1-6558) MEASUREMENT OF ELASTIC CROSS SECTIONS OF p,p-SCATTERING AT SMALL ANGLES AND 632-MeV ENERGY AND THE VERIFICATION OF DISPERSION RELATIONS. Amirkhanov, I. V.; Bystritskii, V. M.; Vertogradov, L. S.; Zul'karneev, R. Ya.; Kutuev, R. Kh.; Murtazaev, Kh.; Nadezhdin, V. S.; Satarov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 21p. (In Russian). Dep. NTIS (U. S. Sales Only).

Preliminary measurements were conducted for $d\sigma/d\Omega$ in the angular region 5 to 29° (center-of-mass system) for 632-MeV incident protons. The measurements were accomplished on a liquid hydrogen target with a threshold telescope of scintillation counters which recorded scattered protons. The results obtained disagree with the measurements of others which were taken at energies of 650, 660, and 657 MeV. The results obtained were used in a phase analysis and in a comparison with predictions of dispersion theories. Extrapolation to $\nu = 0^0$ gave the value $\mathrm{ReA}_{pp}(0^0)$, equal to $(0.54 \pm 0.06) \times 10^{-13}$ cm, which was in agreement with predictions of dispersion relations. (tr-auth)

57239 INVESTIGATION OF ELASTIC PROTON–PROTON SCATTERING IN THE COULOMB AND NUCLEAR INTERFERENCE REGION IN THE ENERGY RANGE 8 TO 70 GeV. Bartenev, V. D.; Beznogikh, G. G.; Buyak, A.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 1, 96-108(Jul 1972). (In Russian).

The results on measuring elastic pp-scattering in the Coulomb and nuclear interaction interference region are presented. The data are taken for $(0.0007 \leq |t| \leq 0.02 \ (\mathrm{GeV/c})^2)$ in the energy range 8 to 70 GeV at the Serpukhov accelerator. It was shown that the ratio α of the real part of the elastic pp-scattering amplitude to the imaginary one varies in the indicated energy range from -0.35 ± 0.05 at $p = 9.39$ GeV/c up to 0.092 ± 0.011 at $p = 69.8$ GeV/c. It is in agreement with the calculations made on the basis of dispersion relations with one subtraction. The present experiment differs from the previous one in applying a hydrogen jet as an accelerator internal target. In the previous experiment the slope parameter of the differential cross section for elastic pp-scattering was measured with a thin polyethylenium target for the same energy range. (auth)

57240 INTERACTION OF 2.43 GeV/c DEUTERONS WITH PHOTOEMULSION NUCLEI. Silesh, E. (Joint Inst. for Nuclear Research, Dubna, USSR); Tolstov, K. D.; Tuchek, I. Yadern. Fiz.; 16: No. 1, 109-13(Jul 1972). (In Russian).

The interactions of 2.43-GeV/c deuterons with the photoemulsion nuclei were studied. Partial cross sections for elastic and inelastic collisions as well as proton stripping were determined. The probability of conserving the deuteron in an inelastic collision with a nucleus was estimated. The experimental results are compared with the diffraction model and other work. (auth)

57241 DEPOLARIZATION IN 612 MeV ELASTIC pn SCATTERING. Glonti, L. N.; Kazarinov, Yu.; M.; Khayatov, M. R. (Joint Inst. of Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 62 No. 6, 1998-2007(Jun 1972). (In Russian).

For measurement of depolarization a polarized proton beam from the Dubna synchrocyclotron ($E = 612$ MeV, $P_1 = 0.332 \pm 0.011$) was scattered by deuteron neutrons. Quasielastic pn scattering events were separated by fast electronic circuits. The third analyzing scattering occurred in a carbon target and was recorded in optical spark chambers. Values of D_{pn} of 0.96 ± 0.14, 0.67 ± 0.11 and 0.49 ± 0.24 were obtained for angles of 52, 94 and 125° (c.m.s.) respectively. An analysis of possible systematic errors is presented. The experimental results are in good agreement with predictions of a phase shift analysis of nucleon-nucleon scattering. (auth)

57242 SCALING METHOD FOR SUPER-HIGH ENERGIES FROM EXPERIMENTAL DATA BELOW 30 GeV. Cecchet, G.; Dolfini, R.; Impellizzeri, F.; Ratti, S. (INFN, Milan). Nucl. Instrum. Methods; 103: No. 3, 555-64(1972).

A general method, not of the Monte Carlo type, is proposed to simulate elementary events at very high energies. Actual experimental data obtained at energies below 30 GeV are scaled up under different scaling hypotheses. The basic principles are discussed and several distributions in the laboratory system are given for the reaction at 65, 100, 150, 200 GeV. (auth)

57243 ENERGETIC CHARACTERISTICS OF INELASTIC INTERACTIONS OF COSMIC NUCLEONS WITH CARBON. Vardanyan, R. A.; Mamidzhanyan, E. A.; Martirosov, R. M. (Erevan Physics Inst.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 6, 449-56(1971). (In Russian).

The energetic characteristics of the inelastic interactions of nucleons with a carbon nucleus within the region of nucleon energies of 760 to 7600 GeV are studied. The average value of the fraction of energy, transferred by nucleon to γ-quanta in carbon, is equal to 0.45 ± 0.03. The partial coefficient of the inelasticity of nucleons in carbon is $k_{\pi^0} > 0.22 \pm 0.02$. (auth)

57244 ANALYSIS OF PRESENT EXPERIMENTAL DATA ON ULTRA-HIGH-ENERGY COSMIC RAYS. Kulikov, G. V.; Khristiansen, G. V. (Moscow State Univ.). Yadern. Fiz.; 15: No. 4, 763-72(Apr 1972). (In Russian).

Experimental data on the energy spectrum and chemical composition of the ultra-high-energy primary cosmic rays are discussed. On the basis of the analysis of these characteristics the conclusions are made on the ultra-high-energy elementary particle interaction character. (auth)

57245 CHARGED PARTICLE PRODUCTION RATIOS AT THE CERN ISR FOR A TRANSVERSE MOMENTUM OF 0.4 GeV/c. Bertin, A. (Univ., Bologna); Capiluppi, P.; D'Agostino-Bruno, M.; Ellis, R. J.; (and others). Phys. Lett.; 41B: No. 2, 201-4(18 Sep 1972).

Experimental results are presented on the production ratios of charged particles in inclusive reactions at ISR energies. The data were taken at a fixed transverse momentum of 0.4 GeV/c. At ISR energies and for $0.1 < x < 0.3$ the production of all charged particles seems to be energy independent, suggesting that limiting distributions have been reached. (auth)

57246 OVERLAP FUNCTION ANALYSIS OF p–p ELASTIC SCATTERING DATA AT ISR ENERGIES. Heckman, P.; Henzi, R. (McGill Univ., Montreal). Phys. Lett.; 41B: No. 2, 189-91(18 Sep 1972).

Recent data from the CERN-ISR are analyzed in terms of a gaussian overlap function in impact parameter space. It is found that the upward concavity in the angular distributions is accurately reproduced. Phenomenological implications are discussed. (auth)

57247 $\bar{p}p$ ANNIHILATION INTO $\pi^+\pi^-$ AND K^+K^- AT 5 GeV/c. Chabaud, V. (CERN, Geneva); Eide, A.; Lehmann, P.; (and others). Phys. Lett.; 41B: No. 2, 209-12(18 Sep 1972).

The differential cross sections for the annihilation processes $\bar{p}p \rightarrow \pi^-\pi^+$ and $\bar{p}p \rightarrow K^-K^+$ were measured at an incident laboratory momentum at 5 GeV/c. Strong backward and forward peaks are observed in the $\pi^+\pi^-$ differential cross sections while the K^+K^- cross-section is shown to have a peak only for K^- going forward. The annihilation cross sections are compared with the cross sections for the crossed channel backward processes $\pi^\pm p \rightarrow p\pi^\pm$ and $K^\pm p \rightarrow pK^\pm$. (auth)

57248 $\bar{p}p$ ANNIHILATION INTO $\pi^+\rho^-$ AT 5 GeV/c. Eide, A. (CERN, Geneva); Lehmann, P.; Lundby, A.; (and others). Phys. Lett.; 41B: No. 2, 225-8(18 Sep 1972).

The differential cross section was measured for the reaction $\bar{p}p \rightarrow \pi^+\rho^-$ at 5 GeV/c, the π^+ being in the cm angular range $0.47 < \cos\theta^{cm}_{\bar{p}\pi^+} < 0.98$, corresponding to $0.12 < -t < 2.40 \ (\mathrm{GeV/c})^2$. The angular distribution has a forward peak with a differential cross section $d\sigma/d\Omega = 4.1 \pm 1.6 \ \mu b/sr$ for $0.94 < \cos\theta^{cm}_{\bar{p}\pi^+} < 0.96$. (auth)

57249 WIDE-ANGLE PRODUCTION OF SLOW ANTIPROTONS AT CERN INTERSECTING STORAGE RINGS. Bogdan, B. (Inst. of Atomic Physics, Bucharest); Cincheza, I.; Cohen, J.; (and others). Phys. Lett.; 41B: No. 2, 221-4(18 Sep 1972).

The ratio of the production of very slow antiprotons to that of pions in the same momentum interval was measured at the ISR by means of nuclear emulsions. Averaged over the interval $0.12\ \mathrm{GeV/c} \leq p_\perp \leq 0.34\ \mathrm{GeV/c}$ and $0 \leq p_{||} \leq 0.2\ \mathrm{GeV/c}$, $N(\bar{p})/N(\pi^-) = 0.063 \pm 0.012$. (auth)

57250 REAL PART OF AMPLITUDE OF ELASTIC pd SCATTERING AT 70 GeV. Zayachki, V. I.; Khristov, L. G.; Zlatanov, Z. M.; Devenski, P. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 5, 949-52(May 1972). (In Russian).

By the method of registration of a nuclear emulsion particle recoil, the differential cross sections were measured for the pd-scattering at 70 GeV in the region of small momentum transfer, $0.0024 \leq |t| \leq 0.1730\ (\mathrm{GeV/c})^2$ wherein the nuclear and Coulomb interference is observed. The real part of the elastic pd-scattering amplitude was determined: $\alpha_{pd} = -0.126 \pm 0.063$. (auth)

57251 RESONANCE PRODUCTION IN SIX PRONG $p\bar{p}$ ANNIHILATIONS AT 2.5 GeV/c. Clayton, J. (Univ. of Liverpool); Mason, P.; Muirhead H.; Renton, P.; Rigopoulos, R. Nucl. Phys.; B47: No. 1, 81-93(1972).

A study of 5000 6-prong pionic annihilations obtained in the CERN 2m hydrogen bubble chamber, and of a larger sample containing 1287 6π events is presented. There is clear evidence of abundant ρ and ω production. Partial cross sections for various resonance channels obtained from maximum likelihood fits are given. Evidence is presented for the production of two resonances at masses of 1.7 and 1.8 GeV in the 4π mass spectrum of the 6π annihilations. In the 7π channel A_2 and ω cuts applied to the $3\pi^\pm 2\pi^\mp \pi^0$ effective mass plot indicate the production of resonances at masses of 2160 ± 20 and 2320 ± 20 MeV. (auth)

57252 $\omega\pi$ RESONANCES AND $\pi\pi$ S-WAVE STRUCTURES AS OBSERVED IN $\bar{p}p$ ANNIHILATIONS AT REST. Frenkiel, P. (College of France, Paris); Ghesquiere, C.; Littestoel, E.; (and others). Nucl. Phys.; B47: No. 1, 61-80(1972).

A detailed analysis of about 7400 events of the type: $\bar{p}p \to \omega^0\pi^+\pi^-$, the annihilations occurring at rest, shows some evidence for the presence of two $\omega\pi^\pm$ resonances with $M \sim 1250$ MeV, spin 1 and opposite parities. The $I = 0$ $\pi^+\pi^-$ system can also be analyzed in some detail in the mass range 700 to 1100 MeV. One of the best interpretations of the data is to assume that the S-wave phase shift δ_0^0 goes through 90, 180 and 270° at 842, 937 and 977 MeV, respectively. (auth)

Strong (Meson-induced)

57253 (CERN-72-10, pp 1-25) PRESENT STATUS ON THE "S-MESON" REGION. Laloum, M. (College de France, Paris).

From Symposium on nucleon-antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

The main results of studies of the S-meson region (1920-1975 MeV/c^2) from missing mass experiments, bubble chamber production, and formation experiments are briefly described. It is concluded that several objects probably exist in the S region. First, convergent indications have been presented around 1970 MeV/c^2. Missing mass studies and elastic scattering both give structures at about 1925-1930 and 1945-1955 MeV/c^2. This is found in agreement with some theoretical ideas suggesting multipole resonances on the A_2 trajectory or quasi-nuclear structures at about M = 2 Mp. (L.B.S.)

57254 (SLAC-PUB-1044) SOME RESULTS FROM A STUDY OF $\pi^- p \to \rho^0 X^0$ AT 15 GeV/c. Leith, D. W. G. S. (Stanford Linear Accelerator Center, Calif.). Apr 1972. 36p. (CONF-720333-1). Dep. NTIS.

From seventh rencontre de moriond conference; Meribel-les-Allues, France (5 Mar 1972).

Results from a wire spark chamber study of the reaction $\pi^- p \to \rho^0 + X^0$ at 15 GeV/c are presented. The pion exchange structures were probed, and the characteristic signature of the pion propagator at small t was studied. Resonances produced include the ρ, f^0, N(1400), and N(1700). Decay angular distributions for the $\pi^- + p \to \rho^0 + n$ interactions were determined as a function of momentum transfer. Differential cross sections and a phase shift analysis of elastic $\pi + \pi$ scattering are also included. (J.F.P.)

57255 ESTIMATION OF PION AND NUCLEON FORM FACTORS FROM ANALYSES OF $\pi^- p \to e^+e^-n$ PROCESS AT $E_{\pi\,\mathrm{kin}}$ = 275 MeV. Berezhnev, S. F.; Vertogradov, L. S.; Dem'yanov, A. V.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 1, 185-92(Jul 1972). (In Russian).

The experimental cross sections were compared with theoretical calculations, based on the dispersion model, where the form factors F_π and F_1^V were taken as independent parameters. The upper limits obtained for the form factors are $F_\pi < 1.25$, $F_1^V < 1.3$ (1 st. deviation), and $F_\pi < 1.36$, $F_1^V < 1.44$ (2 st. deviations). With the assumption that $F_\pi = F_1^V$ the accuracy of determining the form factors improves greatly $F_\pi = F_1^V = 1.07^{+0.14}_{-0.17}$. (auth)

57256 PRODUCTION OF FAST HELIUM AND TRITON NUCLEI IN AN INTERACTION OF HIGH-ENERGY PIONS WITH HEAVY EMULSION NUCLEI. Borisenko, A. I.; Kazanskaya, A. P.; Morozova, P. V.; Takibaev, Zh. S.; Titova, N. S. (Kazakh State Univ., Alma-Ata, USSR). Yadern. Fiz.; 15: No. 4, 749-56 (Apr 1972). (In Russian).

Characteristics of a production of 800-MeV helium nuclei produced in interactions of high-energy pions with heavy emulsion nuclei are examined. Data are given for production of tritium nuclei in heavy nuclei splitting by 7.5-GeV pions. Dependences of the helium and tritium nuclei production cross sections and of the angular and energy distributions on the initial pion energy are investigated. The helium nucleus production probability is shown to follow a law $W \sim \exp(0.11 N_h)$. The proposition is made that some part of the particles among the helium isotopes with kinetic energy more than 100 MeV are particles with mass number 3. (auth)

57257 ELASTIC AND INELASTIC COLLISIONS OF π-MESONS WITH NUCLEONS AT HIGH ENERGIES (REVIEW). Glagolev, V. V.; Tolstov, K. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Fiz. Elem. Chastits At. Yadra; 3: No. 1, 65-143(1972). (In Russian).

A review of experimental data on elastic scattering, generation of particles and resonances, polarization of baryons, and momentum spectra of secondaries obtained in pion-nucleon collisions at high energies is given. The results are compared with theoretical models. (auth)

57258 f AND f′ PRODUCTION IN $K^- p$ INTERACTIONS AT 3.95 GeV/c. Videau, I. (Ecole Polytechnique, Paris); Videau, H.; Rouge, A.; (and others). Phys. Lett.; 41B: No. 2, 213-15 (18 Sep 1972).

A determination of the f′ mass and width, and the characteristics of the f and f′ production in two body $K^- p$ reactions at 3.95 GeV/c are presented. (auth)

57259 SEARCH FOR NARROW RESONANCES IN THE R REGION. Bowen, D. (Northeastern Univ., Boston); Earles, D.; Faissler, W.; (and others). Phys. Rev. Lett.; 29: No. 13, 890-3(25 Sep 1972).

A measurement of the missing-mass, $(mm)^-$, spectrum from the reaction $\pi^- + p \to (mm)^- + p$ at 8 GeV is reported. The data contain 6500 events in the R peak ($M^2 = 2.72 \pm 0.02\ \mathrm{GeV}^2$, $\Gamma = 139 \pm 31$ MeV). The R shape is consistent with either a single Breit-Wigner or several wide resonances, as suggested by bubble-chamber experiments, but inconsistent with the series of narrow resonances reported by the CERN missing-mass group. (auth)

57260 CONFIRMATION OF THE EXISTENCE OF A PARTICLE-UNSTABLE STATE OF THE λ-^{12}C HYPERNUCLEUS. Juric, M. (Inst. of Physics, Belgrade); Bohm, G.; Krecker, U.; (and others). Nucl. Phys.; B47: No. 1, 36-42(1972).

A study was made of the K^- meson absorptions at rest in emulsion nuclei of the type K^- + nucleus $\to \pi^-$ + charged particle + hypernucleus. The existence of the particle unstable resonant state of the $^{12}_{\Lambda}C$ hypernucleus, decaying via $^{12}_{\Lambda}C \to {}^1H + {}^{11}B$, was firmly established. The excitation energy and natural width of this state are about 11 MeV and 0.4 MeV respectively. (auth)

57261 TOTAL CROSS SECTIONS OF THE $\pi^\pm p$ AND $\pi^\pm d$ INTERACTIONS IN THE MOMENTUM REGION 15 TO 60 GeV/c AND GLAUBER CORRECTION. Gorin, Yu. P.; Denisov, S. P.; Donskov, S. V.; (and others) (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 15: No. 5, 953-8(May 1972). (In Russian).

Total cross sections for the interaction of π^--mesons with protons and deuterons at momenta 15 to 60 GeV/c were measured. The Glauber correction was found using the data on total π^+-meson cross sections which were obtained with the same set-up earlier. It follows from the experimental results that a parameter $\langle r^{-2} \rangle$, which determines the Glauber correction, increases with increase of momentum. (auth)

57262 TESTS OF s-AND t-CHANNEL HELICITY CONSERVATION IN $p\pi^+\pi^-$, $K^-\pi^+\pi^-$ AND $\pi^\pm\pi^+\pi^-$ PRODUCTION IN 16 GeV/c $\pi^\pm p$ AND 10 GeV/c $K^- p$ INTERACTIONS. Aachen-Berlin-Bonn-CERN-Cracow-Heidelberg-London-Vienna-Warsaw Collaboration. Nucl. Phys.; B47: No. 1, 51-60(1972).

Necessary conditions for s- and t-channel helicity conservation are tested for $p\pi^+\pi^-$, $K^-\pi^+\pi^-$ and $\pi^\pm\pi^+\pi^-$ states produced in 16

GeV/c $\pi^{\pm}p$ and 10 GeV/c $K^{-}p$ interactions by means of a method which is independent of specific spin-parity assignments to these states. It is found that the production of $p\pi^{+}\pi^{-}$ states is generally consistent with t-channel helicity conservation for masses up to 2.4 GeV, but that for $\pi^{\pm}\pi^{+}\pi^{-}$ and $K^{-}\pi^{+}\pi^{-}$ some inconsistency with t-channel helicity conservation is found, primarly in the $A_1^{\pm}$ and Q^{-} mass regions. S-channel helicity conservation is excluded for all states. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstracts 57242 and 57736.

General

Refer also to abstracts 57211, 57394, 57480, 57484, and 57737.

57263 (COO—264-617) THEORETICAL RESEARCH IN ELEMENTARY PARTICLE PHYSICS. Final Report, August 1971—March 1972. (Chicago Univ., Ill.). 1972. Contract AT(11-1)-264. 9p. Dep. NTIS.

Research in theoretical high-energy physics is summarized. A list of publications is included. (J.F.P.)

57264 SCALING OF SEMI-INCLUSIVE DISTRIBUTIONS AND THE FEYNMAN GAS MODEL. Huskins, J. (Imperial Coll. of Science and Technology, London). Nucl. Phys.; B46: No. 2, 547-56(1972).

Scaling of semi-inclusive distributions proposed recently by Koba, Nielsen and Olesen is considered. It is shown that it does not follow just from scaling of the inclusive distributions and pionization. Specific examples are considered, including the Feynman gas model. (auth)

57265 DEVELOPMENTS IN THE PHYSICS OF ELEMENTARY PARTICLES. Ashmore, A. (Science Research Council, Daresbury, Eng.). Nature (London); 239: No. 5366, 34-5(1 Sep 1972).

It is stated that there appear to be signs of a breakthrough in the understanding of the structure and interactions of elementary particles. Subjects discussed include elastic and inelastic scattering at high energies, probing with electrons, and the exploration of strong interactions using neutrino beams. (UK)

57266 QUANTUM-MECHANICAL EFFECT WITHOUT FORCE FOR SPINNING PARTICLES. Farago, P. S. (Univ. of Edinburgh). Lett. Nuovo Cim.; 5: No. 4, 305-8(23 Sep 1972).

A determination is made as to whether a proposed thought experiment could unequivocally confirm the validity of the equation $F = \text{grad}\,(\mu,B) - (1/c^2)\,\partial(\mu \times E)/\partial t$ for an interference effect in a classical nonrelativistic force acting on a pointlike neutral dipole particle of magnetic moment μ with E and B being the electric and magnetic fields in the rest frame of the particle. It is shown that this is not the case. (J.F.P.)

57267 MEANING OF THE IMPACT PARAMETER IN THE MULTIPLE-PRODUCTION PROCESSES. Calucci, G.; Jengo, R. (Univ., Trieste, Italy). Lett. Nuovo Cim.; 5: No. 4, 373-6(23 Sep 1972).

A way to give a consistent definition of the impact parameter in the case of multiple production is discussed. (J.F.P.)

57268 CONSTRAINTS ON THE BEHAVIOR OF THE CROSS SECTIONS OF ELASTIC AND INELASTIC PROCESSES AT HIGH ENERGIES. Logunov, A. A.; Mestvirishvili, M. A.; Khrustalev, O. A. (Inst. of High Energy Physics, Serpukhov, USSR). Fiz. Elem. Chastits At. Yadra; 3: No. 1, 3-64(1972). (In Russian).

A review is given of the results concerning the cross sections of elastic and inelastic processes at high energies which were strictly proved on the basis of the fundamental principles of the quantum field theory. For this purpose the analytical properties of the amplitudes of elastic and inelastic processes were studied as functions of angle variables and the possibility of extending the corresponding holomorphy domains by using the unitarity condition. This allows one to translate the results of the axiomatic consideration into a simple language which corresponds almost completely to the semiclassical description of scattering phenomena. Besides the physical consequences in this review, the harmonic measure method—the mathematical tool to be used in estimating the scattering amplitude is represented. (auth)

57269 VOLUME OF LONGITUDINAL PHASE SPACE. Kajantie, K. (Univ. of Helsinki); Karimaeki, V. Ann. Acad. Sci. Fenn., Ser. A VI; No. 395, 1-13(1972).

The volume of longitudinal phase space is evaluated approximately by using the saddle point method. The leading term and the first correction term of order 1/n, n = particle number, are included. It is shown that this method works only if log E < n and the asympotic form valid for $E \rightarrow \infty$ has to be derived by different means. Similar statements concerning the high-energy behavior apply also to the phase space integral cut in transverse momenta. (auth)

57270 EQUATIONS FOR BOUND STATES (QUARKS). Bogolyubov, P. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Fiz. Elem. Chastits At. Yadra; 3: No. 1, 144-74(1972). (In Russian).

A few variants of the quark models, based on the corresponding equations for the bound states, are considered. The results of these models for the internal properties of the elementary particles are in good agreement with experiment. There is also shown the connection between the quark models and the coherent state method for high energy scattering. (auth)

57271 CROSSING EQUATIONS AND SPIN STRUCTURE. II. FB → FB AND BB → FF REACTIONS. Actor, Alfred (Westfield Coll., London). Phys. Rev., D; 6: No. 6, 1625-37(15 Sep 1972).

A study of the spin structure of two-body helicity amplitudes begun in a previous paper is extended to include general-mass reactions with two fermions and two bosons. The Trueman—Wick matrix joining the FB → FB and BB → FF channels (B = boson, F = fermion) is transformed into a direct sum of simple matrices M_i. The latter are 2 × 2 matrices whose elements are simple polynomials in s and t. The new s- and t-channel amplitudes related by the M_i are proportional to k.r. (kinematically regular, i.e., free from kinematic singularities and simple zeros) functions of s and t. Thus one obtains a complete set of new k.r. amplitudes for general-mass FB → FB reactions. As before, one can use the simple crossing algebra to expand the new k.r. amplitudes in terms of an elegant set of invariant amplitudes. The coefficients of these invariant amplitudes are simple functions of the crossing and scattering angles. Within a given spin class of reactions (e.g., those reactions with spins $\frac{1}{2} + 0 \rightarrow J + 0$) these coefficients are also simple functions of the spins. The procedure is described by two detailed examples with FB → FB channel spins $\frac{1}{2} + 0 \rightarrow \frac{1}{2} + 0$ and $\frac{1}{2} + 0 \rightarrow \frac{3}{2} + 0$. A description is given of how one can achieve a general classification of invariant amplitudes based on the different kinematic roles played by different invariant amplitudes. The simplest possible connections between this classification scheme and observable dynamical situations are discussed. (auth)

57272 CROSSING EQUATIONS AND SPIN STRUCTURE. I. BB → BB AND FF → FF REACTIONS. Actor, Alfred (Westfield Coll., London). Phys. Rev., D; 6: No. 6, 1612-25 (15 Sep 1972).

The Trueman—Wick crossing matrix for general-mass BB → BB and FF → FF reactions (B = boson, F = fermion) is rearranged into a direct sum of 2 × 2 matrices whose matrix elements are simple polynomials in s and t. The s- and t-channel amplitudes related by this new matrix are proportional to k.r. (kinematically regular, i.e., no kinematic singularities or simple zeros) functions of s and t. Thus new k.r. amplitudes are constructed (simultaneously in both channels) for general-mass BB → BB and FF → FF reactions. (In addition we construct new k.r. amplitudes for general-mass BB → FF reactions.) These are not the usual "parity-conserving" k.r. amplitudes. Parity invariance is not assumed. When parity is conserved, roughly half of the new k.r. amplitudes are zero. A noncovariant procedure, based on the simplicity of the new crossing algebra, is developed for expanding the new k.r. amplitudes in terms of an elegant set of invariant amplitudes. It has the feature of very clearly relating the spin structure of a reaction to the crossing matrix for this reaction. One obtains the coefficients of invariant amplitudes as functions of the crossing angles and the particle spins. Highly ordered expressions for the spin structure are the result. This order makes possible a classification of invariant amplitudes based on the unique kinematic role played by each in the spin structure. Such a kinematic classification can be related directly to various observable dynamical situations. Should the latter occur in nature, the scheme would have dynamical content. Three examples of BB → BB reactions are given to illustrate our formalism. (auth)

57273 SOLVABLE RELATIVISTIC UNITARY MODEL FOR MULTIPARTICLE PRODUCTION. Redei, L. B. (CERN, Geneva). Nuovo Cim.; 11A: No. 2, 279-94(21 Sep 1972).

By making a Hermitian ansatz for the K-matrix and solving the resulting equation for the scattering amplitude a model is derived for multiparticle production for which the amplitude can be given in explicit closed form. The amplitude satisfies many-particle unitarity exactly (there is a nonvanishing amplitude for the production of not more than N particles, where N is arbitrary but fixed). The requirement of Lorentz invariance is also satisfied. Analyticity properties are discussed, and the elastic amplitude is shown to be the boundary value of a single analytic function of s (s being the center-of-mass energy squared) having branch points at production thresholds. (auth)

57274 HIGH ENERGY PHYSICS INDEX. VOLUME 10, NO. 18, 1972. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 78p.

57275 HIGH ENERGY PHYSICS INDEX. VOLUME 10, NO. 17 1972. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 72p.

57276 EQUAL-TIME AND NULL-PLANE COMMUTATORS OF CONSERVED CURRENTS ON THE LIGHT CONE. Kummer, W. (Univ. of Pennsylvania). Phys. Rev., D; 6: No. 6, 1670-5(15 Sep 1972).

The usual manifestly conserved expansions of current densities on the light cone do not lead to the correct commutation relations at equal times or on a lightlike plane. Therefore a piece must be added which is compatible with current conservation only for a specific light-cone singularity, namely, $(z^2 - i\epsilon z_0)^{-1}$, which obeys $\Box^{(z)} (z^2 - i\epsilon z_0)^{-1} = 0$. A close relation exists between such a non-manifestly conserved addition to the operator expansion and the well-known phenomenon of a noncausal part in the invariant function of the matrix element between one-particle states. (auth)

57277 DIFFRACTIVE DISSOCIATION WITHIN MULTIPERIPHERAL DYNAMICS. Abarbanel, H. D. I.; Chew, G. F.; Goldberger, M. L.; Saunders, L. M. (Princeton Univ., N. J.). Contract AT (30-1)-4159. Ann. Phys. (N. Y.); 73: No. 1, 156-79(Sep 1972).

The relation of diffractive dissociation to multiperipheral dynamics is explored within the framework of the ABFST model. After splitting the kernel of the integral equation into "resonance" and "Pomeranchuk" components, a variational technique is employed to treat the Pomeranchuk component as a small perturbation. The corresponding perturbed structure of the Fredholm determinant is developed in detail, leading to identification of a small dimensionless parameter η_P which measures the strength of the AFS branch point and thereby sets the scale of Regge fine structure near J = 1. It is shown that η_P also determines the probability of diffractive dissociation into large masses and thus is subject to experimental determination. (auth)

57278 SPIN STRUCTURE OF HIGH-ENERGY MULTIPLE SCATTERING. Drechsler, W. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Ann. Phys. (N. Y.); 73: No. 1, 257-90(Sep 1972).

A multichannel K-matrix formalism is used to unitarize the amplitudes for elastic scattering and diffraction dissociation written down in the impact-parameter representation. The inelastic intermediate states in the unitarity relations are effectively represented by a set of quasi-two-particle states. The complications due to nonvanishing spins are considered and the constraints resulting from a definite (natural or unnatural) parity in the s- and t-channel are investigated. It is found that the Pomeranchuk contribution can be built up from multiple exchanges of lower lying trajectories. The Pomeranchuk coupling in helicity flip transitions turns out in this model to be logarithmically suppressed with increasing energy compared to the corresponding helicity nonflip couplings of the "vacuum trajectory." The coupling determining the imaginary parts of the helicity nonflip elastic scattering and diffraction dissociation amplitudes is found to correspond to natural parity exchanged in the t-channel only. Contrary to this the real parts of the amplitudes for helicity nonflip elastic scattering diffraction dissociation receive in this model at large energies contributions from both natural and unnatural parity exchange in the t-channel. The same is true for the Pomeranchuk contributions to helicity flip elastic scattering and diffraction dissociation processes which are, already in lowest order rescattering, determined by a mixture of natural and unnatural parity exchanged in the t-channel. (auth)

57279 SEMI-INCLUSIVE SCALING IN FEYNMAN'S GAS (LIQUID) MODEL. Olesen, P. (Univ. of Copenhagen). Nucl. Phys.; B47: No. 1, 157-73(1972).

The semi-inclusive cross section for $a + b \rightarrow c + (n - 1)$ charged + anything neutral is investigated in Feynman's gas (liquid) model, where only the two-particle inclusive correlation function is taken into account. It is shown that this model leads to the semi-inclusive scaling recently proposed by Koba, Nielsen and Olesen (for those multiplicities where the model leads to positive definite cross sections). The general case where many-particle correlations are included is briefly discussed. It is conjectured that for multiplicities $n \gg \langle n \rangle$ the semi-inclusive distribution function factorizes in momentum and "relative multiplicity" $n/\langle n \rangle$. The experiment $K^+ + p \rightarrow K^0 + n$ charged + anything neutral is compared with Feynman's gas model. Qualitative agreement is found. (auth)

Electromagnetic

Refer also to abstracts 57222, 57413, 58006, and 58007.

57280 (BNL-17194) LECTURES IN LIGHT CONE PHYSICS. Preparata, Giuliano (Rome Univ. (Italy). Istituto di Fisica. Istituto Nazionale di Fisica Nucleare, Rome (Italy). Brookhaven National Lab., Upton, N. Y.). Aug 1972. 68p. Dep. NTIS.

The progress which was achieved through the configuration space description of deep inelastic processes is reported and the realization is pointed out that in such formulations only the behavior of products of current operators near the light cone must be considered. The physics of the light cone, light cone expansions and technology, light cone description of deep inelastic scattering off a nucleon, the light cone and $e^+ + e^-$ colliding beam physics, and crossing in light cone physics are treated. (J.F.P.)

57281 (DESY-72/39) ELECTRON-POSITRON ANNIHILATION INTO HADRONS AT HIGH ENERGIES. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge. Dept. of Mathematics); Wu, Tai Tsun (Harvard Univ., Cambridge, Mass. Gordon McKay Lab. Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jul 1972. Contract AT(11-1)-3227. 17p. Dep. NTIS.

The annihilation processes of $e^+ + e^- \rightarrow$ hadrons are discussed. In the limit of extremely high energies with the transverse momenta of the hadrons fixed, a given reaction of this kind proceeds by the annihilation of this pair into two virtual photons which turn into two fireballs of hadrons. It is predicted that final-state interaction between the two fireballs is negligible in this limit, and consequently pionization products do not occur. Thus electron-positron annihilation is qualitatively very different from the hadron-hadron interaction. Experimental consequences or tests are discussed. (auth)

57282 (DNPL/P-133) CAN THE PION FORM FACTOR BE DETERMINED FROM PION ELECTROPRODUCTION? Kellett, B. H.; Verzegnassi, C. (Daresbury Nuclear Physics Lab. (England)). Aug 1972. 30p. Dep. NTIS (U. S. Sales Only).

The standard procedures for obtaining the pion form factor from single pion electroproduction experiments are examined in detail. Unfortunately, the least model-dependent quantity that can be determined from experiment contains an unknown function of t and k^2. There is clear evidence that this unknown term cannot be neglected, and this introduces an ambiguity into the determination of $F_\pi (k^2)$ that is not resolved by present experiments. A less ambiguous way of interpreting the data is proposed, and a kinematical region in which further experiments would be useful is suggested. (auth)

57283 (JINR-P2-6540) CONTRIBUTION OF RADIATION OF HARD PHOTONS BY PROTONS IN THE RADIATION CORRECTION TO THE CROSS SECTION OF ep-SCATTERING AT SMALL ANGLES. Vanzha, A. P.; Pak, A. S.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is shown that the contribution of radiation of hard photons by protons in radiative correction to the cross section of ep-scattering at small angles is negligibly small. Thus, it is possible to utilize polar approximations for the amplitude of the nucleonic Compton effect for the purpose of calculations of radiation corrections. (tr-auth)

57284 (NP-19427) PHENOMENOLOGICAL ANALYSIS OF SINGLE PION PHOTOPRODUCTION ON NEUTRON IN THE REGION OF P_{11}, D_{13}, AND S_{11} PION-NUCLEON RESONANCES. Proia, A.; Sebastiani, F. (Rome Univ. (Italy). Istituto di Fisica). 17 Mar 1972. 32p. (In Italian). Dep. NTIS (U. S. Sales Only).

Some recent data of photoproduction on neutrons in the second resonance region were analyzed by using the generalized isobaric model. Some solutions were obtained for data from the interaction $\gamma n \rightarrow p\pi^-$ only; others included also data from the interaction $\gamma n \rightarrow n\pi^0$. Additional fits were carried out in which the imaginary parts, B, of background terms were required to be small ($-3.10^{-2} \leq B \leq 3.10^{-2}$). Three fits from the $p\pi^-$ and $\pi^0 n$ data were also carried out for $C_{r\gamma} (D_{13}) = 0$, $C_{r\gamma} (S_{11}) = 0$, $C_{r\gamma} (P_{11}) = 0$, with the imaginary parts constrained to be small. It was found that both the two free solutions and one of the constrained ones show a large e.m. coupling of the isobaric nucleon state P_{11} in the $n\gamma$ channel. (14 figures, 3 tables) (R.W.R.)

57285 (NP-19445) CONTRIBUTION TO SIXTH ORDER ELECTRON AND MUON ANOMALIES. II. Barbieri, R. (Scuola Normale Superiore, Pisa (Italy)); Caffo, M. (Bologna Univ. (Italy). Istituto di Fisica); Remiddi, E. (Bonn Univ. (West Germany). Physikalisches Institut). Jul 1972. 9p. Dep. NTIS (U. S. Sales Only).

The sixth-order contributions to the electron and muon anomalous gyromagnetic ratios are evaluated from Feynman graphs. (J.F.P.)

57286 (ORO–3992-107) RUNAWAY MODES IN DIPOLE ELECTRODYNAMICS WITH SHADOW STATES. Chiang, C. C. (Texas Univ., Austin. Center for Particle Theory). Sep 1972. 22p. (CPT–142). Dep. NTIS.

The model in which a nonrelativistic harmonically bound electron interacts with the dipole part of the electromagnetic field is studied. With the introduction of a shadow electromagnetic field, it is found that, in contrast with the conventional treatment, the unpleasant runaway modes do not occur. The scattering states of a physical photon scattered by an electron are also given, and it is shown that these physical states form a set of orthonormal states. (auth)

57287 PION POLARIZABILITY, VIRTUAL COMPTON-EFFECT AND $\pi \rightarrow e\nu\gamma$ DECAY. Terent'ev, M. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 1, 162-73(Jul 1972). (In Russian).

The amplitude for $\gamma\gamma \rightarrow \pi\pi$ process was calculated. It is shown that this amplitude can be determined with high accuracy, if there are known the following two parameters: $\langle r^2 \rangle^{1/2}$ —the radius of pion, k-its polarizability. The quantity k is related to the form factor of the axial current in $\pi \rightarrow e\nu\gamma$ decay. A numerical value of $k \simeq 0.1\alpha/\mu^3$ was derived from the data on $\pi \rightarrow e\nu\gamma$ decay probability. It was noted that such a value of k leads to considerable shifts of levels in π-mesoatoms. (auth)

57288 VIOLATION OF SCALE INVARIANCE IN HADRON ELECTROPRODUCTION DUE TO CONTRIBUTION OF CUTS. Shabel'skii, Yu. M. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 1, 193-7(Jul 1972). (In Russian).

It was shown that the theory of complex moments predicts violation of scale invariance in hadron electroproduction due to the contribution of cuts. The extent of such a violation is discussed. The corrections for the functions W_1 and W_2 due to a double-reggeon cut were calculated. (auth)

57289 STIMULATED EMISSION OF RADIATION BY ELECTRONS IN PLANE ELECTROMAGNETIC WAVES. Ternov, I. M.; Khalilov, V. R. (Moscow State Univ.). Yadern. Fiz.; 16: No. 1, 174-84(Jul 1972). (In Russian).

The problem of the influence of frequency, spectrum width, and polarization of a weak wave on its amplification caused by an electron, moving in the strong wave field, is considered. The possibility of heating the electrons during their interaction with electromagnetic waves, when the main contribution is given by "multiquantum Compton-effect," is also discussed. (auth)

57290 PHOTONEUTRINO PROCESSES IN A STRONG FIELD. Gal'tsov, D. V.; Nikitina, N. S. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 62: No. 6, 2008-12(Jun 1972). (In Russian).

Photon emission by a neutrino (antineutrino) and disintegration of a photon into a neutrino—antineutrino pair in a crossed electromagnetic field are considered. The matrix elements are calculated by the Furry pattern with exact allowance for the external field. It is demonstrated that only the divergence of the axial current yields a contribution and this permits one to take into account hadron vacuum polarization (if neutral currents exist). The magnitude of the effects in pulsar magnetic fields is estimated. (auth)

57291 RADIATION FROM A PARTICLE IN STATIC ELECTRIC AND MAGNETIC FIELDS. Stewart, P. (Univ. of Manchester, Eng.). Lett. Nuovo Cim.; 4: No. 14, 704-6(5 Aug 1972).

In order to obtain a power law high frequency cutoff for synchrotron and nonlinear inverse Compton processes, which are important mechanisms in radio astrophysics, an energy distribution for the radiating particle is used. For this reason mechanisms which give cutoffs which are more weakly dependent on frequency than exponential are of interest. Such a mechanism arises when a charged particle is released from rest in a region where static electric and magnetic fields are equal and at right angles to each other. In order to show the type of cut-off obtained, the radiation emitted into a plane whose normal is parallel to the electric field is studied. The problem may be solved exactly. (J.F.P.)

57292 MODIFICATION OF THE COULOMB LAW IN UNIFORM AND STATIC MAGNETIC FIELD. Loskutov, Yu. M.; Skobelev, V. V. (Moscow State Univ.). Yadern. Fiz.; 15: No. 4, 773-5(Apr 1972). (In Russian).

The influence of the vacuum polarization in the presence of a static and uniform magnetic field on the point charge electrostatic is considered. (auth)

57293 PARTON MODEL FOR $\gamma\gamma$-SCATTERING. Perlovskii, L. I.; Kheifets, E. P. (Novosibirsk State Univ., USSR). Yadern. Fiz.; 15: No. 4, 776-80(Apr 1972). (In Russian).

In the parton model of the $\gamma\gamma \rightarrow$ hadrons process the following result was obtained in the region $s \gg |q_1^2|, |q_2^2| \gg 1$ GeV^2: the cross section is a function of one variable $s\sigma_{\gamma\gamma} = \varphi(s/q_1^2q_2^2)$ where $s = 2q_1q_2$, q_1 and q_2 are photon four-momenta. (auth)

57294 DEEP INELASTIC ep-SCATTERING IN A PERTURBATION THEORY. Gribov, V. N.; Lipatov, L. N. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 15: No. 4, 781-807(Apr 1972). (In Russian).

Deep inelastic ep-scattering is considered in vector and pseudoscalar theories with conditions $g^2 \ll 1$, $g^2 \ln q^2 \sim 1$. In the vector theory deep inelastic scattering amplitudes are shown to increase with increasing of q^2 at fixed ω in spite of the fast decreasing of the electromagnetic form factors. (auth)

57295 RADIATION OF AN OSCILLATOR MOVING ALONG THE INTERFACE. Kostanyan, F. A.; Mergelyan, O. S. (Inst. of Radio Physics and Electronics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 6, 472-80(1971). (In Russian).

Radiation of an oscillator passing along an interface between two isotropic media is considered. The expressions for the far-zone fields and energy losses are derived. The angular and frequency distribution of the radiation and its peculiarities owing to the availability of an interface are investigated. (auth)

57296 INVESTIGATION OF THE ELECTROMAGNETIC FORM FACTOR OF A π MESON BY A DISPERSION RELATION METHOD. Shcherbin, Yu. P. Vestn. Leningrad. Univ., No. 16, Fiz. Khim.; No. 3, 7-11(Aug 1971). (In Russian).

A dispersion sum rule and dispersion relation, involving the information on the modulus and the phase of electromagnetic pion form factor in the timelike region of momentum transfer squared, are tested under different assumptions with respect to the form factor behavior. The causes of the dispersion sum rule violation are analyzed and the possibility of virtual state existence in the channel of J = 1, T = 1 $\pi\pi$ scattering is considered. (auth)

57297 GAUGE INVARIANCE AND SCALING IN RESONANCE MODELS OF THE VERTEX. Leutwyler, H. (Univ., Bern). Helv. Phys. Acta; 45: No. 1, 182-96(1972).

The vertex function associated with the interaction of a virtual photon of mass q^2, a scalar field of mass k^2 and a scalar particle sitting on its mass shell are analyzed. The singularities in k^2 and in q^2 are taken to be simple poles characterized by linear trajectories. The behavior of the vertex for high virtual masses is assumed to be governed by a scaling law which corresponds to a canonical singularity on the light cone. The general gauge invariant vertex function consistent with these requirements is constructed. (auth)

57298 ELECTRON RADIATION IN A FOCUSING MAGNETIC FIELD ALLOWING FOR SPIN STATES. Kholomai, B. V.; Zhukovskii, V. Ch. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 1, 66-72(1972). (In Russian).

The intensity of radiation of an electron was calculated making due allowance for its spin states. The basis of this calculation was the wave functions of an electron, conforming to the Dirac equation in an axially-symmetric magnetic field of a weakly-focused type. (tr-auth)

57299 POLARIZATION OF INSTANTANEOUS SYNCHROTRON RADIATION. Nikitin, M. M. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 164-5(1972). (In Russian).

The degree of linear polarization of 1.5 GeV synchrotron radiation was a function of the orientation of the plane of polarization. The angular distribution of the total intensity of radiation was experimentally examined. To the extent that actual observation was conducted with an extremely small portion of the trajectory of electron motion, polarization of instantaneous radiation was recorded, in confirmation of theory. (K.S.W.)

57300 INDUCED EMISSION BY AN ELECTRON POSSESSING AN ANALOGOUS MAGNETIC MOMENT IN THE FIELD OF A PLANE ELECTROMAGNETIC WAVE. Klimenko, Yu. I.; Khudomyasov, A. I. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 28-33(1972). (In Russian).

The dependence of induced radiation of electrons which possess an anomalous magnetic moment on polarization during motion through a field of a plane, circularly-polarized electromagnetic wave was studied. The dependence of such induced radiation on frequency and on the intensity of the secondary wave arising in the system was also investigated. Allowing for an anomalous magnetic moment of the electron leads to a frequency shift, a power change, and spin effects. (tr-auth)

57301 QUARK MODEL AND NEUTRAL REACTOR MESON PHOTOPRODUCTION PROCESSES ON NUCLEONS AND NUCLEI. Akhiezer, A. I.; Rekalo, M. P. (Physical-Technical Inst., Kharkov). Fiz. Elem. Chastits At. Yadra; 3: No. 1, 175-222(1972). (In Russian).

The consequences of the quark model for neutral vector mesons photoproduction processes on nucleons and nuclei are investigated. The predictions of the model concerning the energy dependence of differential cross sections, the values of the real parts of the vector meson photoproduction and Compton scattering amplitudes, the relations between different cross sections, the A-dependence of the cross sections for photoproduction of V-mesons on nuclei are in agreement with experimental data. (auth)

57302 RADIATION OF AN OSCILLATING CHARGE IN A THREE-DIMENSIONAL PERIODICALLY INHOMOGENEOUS MEDIUM. Kostanyan, F. A.; Mergelyan, O. S. (Inst. of Radio Physics and Electronics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 6, 481-6(1971). (In Russian).

In the perturbation theory approximation the radiation of the uniformly moving oscillating charge in a medium the dielectric permeability of which permits the expansion into the harmonic function series is considered. The electromagnetic fields and the radiation energy losses are calculated. (auth)

57303 RADIATION FROM A FREE ELECTRON INTERACTING WITH A CIRCULARLY POLARIZED LASER PULSE. Steiger, A. D.; Woods, C. H. (Univ. of California, Livermore). Phys. Rev., D; 6: No. 6, 1468-73(15 Sep 1972).

The radiation from an electron driven by an intense circularly polarized electromagnetic wave of finite duration and smoothly varying intensity is analyzed. The effect of radiative reaction on the electron orbit is accounted for self-consistently. Expressions are derived for the total scattering cross section, the angular and spectral distributions, and the polarization tensor of the scattered radiation. The results are relativistically correct, and exhibit the dependence of the characteristics of the scattered radiation on the intensity profile of the incident radiation. (auth)

57304 FORM FACTORS IN THE BETHE–SALPETER MODEL. Singh, Santokh (Univ. of Delhi). Phys. Rev., D; 6: No. 6, 1648-54(15 Sep 1972).

The asymptotic behavior of the nucleon form factors has been discussed treating the nucleon as a composite particle. The relevant Bethe–Salpeter equation is solved treating the nucleon both as a scalar particle as well as a fermion. For a spin-0 bound state the form factor goes to zero as $(1/q^2)^2$, while for spin-$1/2$ bound state of a pseudoscalar meson and a spin-$1/2$ object the asymptotic behavior of the form factors depends on the strength of the interactions and they behave as $1/(q^2)^{2\alpha}$ where $\alpha = 1 + (1 + \lambda)^{1/2}$, λ being the strength of the interactions. (auth)

57305 CLASSICAL THEORY OF PARTICLES INTERACTING WITH ELECTROMAGNETIC AND MESONIC FIELDS. III. Rosenblum, Arnold; Havas, Peter (Temple Univ., Philadelphia). Phys. Rev., D; 6: No. 6, 1522-8(15 Sep 1972).

In a recent paper, the general form of the laws of motion was found for particles which are multipole sources of coupled electromagnetic and mesonic fields. In paper II of this series, a systematic approximation method was developed for the solution of the nonlinear field equations consistent with the equations of motion to any given order in the constant e coupling the electromagnetic to the mesonic field. In this paper, the resulting first-order equations of motion (both for field theory and the theory of action at a distance) are used to calculate the cross sections for all processes resulting from incident electromagnetic or neutral or charged scalar mesonic waves. In all cases, the results agree with the cross sections found in zeroth order, neglecting the interaction of the electromagnetic and the charged meson fields, by various authors. They also are consistent with the principle of detailed balancing. (auth)

57306 CLASSICAL THEORY OF PARTICLES INTERACTING WITH ELECTROMAGNETIC AND MESONIC FIELDS. II. Shieve, William C. (Univ. of Texas, Austin); Rosenblum, Arnold; Havas, Peter. Phys. Rev., D; 6: No. 6, 1501-22(15 Sep 1972).

In a recent paper by Havas, the general form of the laws of motion was found for particles which are multipole sources of coupled electromagnetic and mesonic fields. After briefly outlining the derivation of these laws for the case of simple poles of the fields, a systematic approximation method is developed for the solution of the nonlinear field equations consistent with the equations of motion to any given order in the constant e coupling the electromagnetic to the mesonic field; this method is analogous to the ''fast approximation method'' for the corresponding problem of the general theory of relativity. The field equations are solved in first order by the method of Riesz potentials, taking all fields to be retarded, and the results are given in integral form. The integrals are then evaluated under the assumption of slow motion and small oscillations. The corresponding results for time-symmetric fields and for action-at-a-distance theory are indicated in an appendix. (auth)

57307 CONFORMAL INVARIANCE AND BJORKEN SCALING. Etim, E. (Univ., Naples). Phys. Lett.; 41B: No. 2, 169-72 (18 Sep 1972).

Invoking conformal invariance of the electromagnetic vertices $\gamma\pi\pi$ and γNN the structure functions of the pion and the nucleon are calculated and it is shown that they scale in the Bjorken limit only if the dimensions of the corresponding fields are canonical. (auth)

57308 ASYMPTOTIC BEHAVIOR OF THE $\gamma\gamma$ FORWARD SCATTERING AMPLITUDE IN THE MULTIPERIPHERAL ABFST MODEL. Skobelev, V. V. (Moscow State Univ.). Phys. Lett.; 41B: No. 2, 167-8(18 Sep 1972).

The absorptive part of the $\gamma\gamma$ forward scattering amplitude off the mass shell is calculated in the multiperipheral ABFST model. The verification of the predictions of the ABFST model in ee and e^-e^+ colliding-beam experiments is suggested. (L.B.S.)

57309 SECOND-ORDER RADIATIVE CORRECTIONS TO THE TRIANGLE ANOMALY. I. DeRaad, Lester L. Jr.; Milton, Kimball A.; Tsai, Wu-yang. (Univ. of California, Los Angeles). Phys. Rev., D; 6: No. 6, 1766-80(15 Sep 1972).

Lowest-order radiative corrections to the pion-photon-photon vertex are calculated in the pseudoscalar $\pi N\bar{N}$ theory. Causal analysis of two- and three-particle exchange processes is used, in the context of Schwinger's source theory, to calculate the spectral weight function for the vertex function. Evaluated at zero momentum transfer squared, this vertex function gives the so-called triangle anomaly in the relation between the pseudoscalar and axial-vector couplings, in second order. A nonzero result is found, giving a total anomaly through this order proportional to $1 + \alpha/2\pi$. This discrepancy is due to the fact that the pseudoscalar form factor was normalized at zero momentum transfer squared, rather than at $3m^2/\ln(\mu^2/m^2)$, where μ is the fictitious photon mass. Independent of the choice of normalization point, there exist radiative corrections to the low-energy theorem for π^0 decay. (auth)

57310 ELECTROMAGNETIC FORM FACTORS OF THE NUCLEON IN PERTURBATION THEORY. Shimizu, Yoshimitsu (Tokyo Univ.). Phys. Rev., D; 6: No. 6, 1723-34(15 Sep 1972).

The asymptotic behavior of the electromagnetic form factors of the nucleon is calculated in a field-theoretical model. By making use of the technique of the Mellin transform, all terms of order larger than $1/q^2$ in each order of perturbation theory for a set of ladderlike graphs are summed to obtain the charge form factor F_1. For the magnetic form factor F_2, the same technique is used to sum all terms of order larger than $1/(q^2)^2$. Special attention is paid to investigate whether the scaling law $F_2 \propto F_1/q^2$ holds or not. It is found that there are conditions for the form factors to scale. (auth)

57311 SOME CONSEQUENCES OF LIGHT-CONE DOMINANCE FOR INCLUSIVE ELECTROPRODUCTION. Nachtmann, O. (Univ. of Princeton, N. J.). Phys. Rev., D; 6: No. 6, 1718-22(15 Sep 1972).

A simple light-cone or parton model for inclusive electroproduction in the target fragmentation region is investigated. A general statement of helicity independence, a sum rule which tests the absence of partons with isospin $>1/2$, and various relations testing the isospin and hypercharge structure of partons are derived. (auth)

57312 REST MASSES OF WAVE QUANTA. Cole, K. D. (La Trobe Univ., Bundoora, Australia). Phys. Lett.; 41A: No. 4, 325(9 Oct 1972).

A criticism of previous work on the photon rest mass is discussed. The criticism is answered, and the work is clarified. (J.F.P.)

57313 REST MASS OF THE PHOTON: A REPLY TO K. D. COLE. Lee, A. R. (La Trobe Univ., Bundoora, Australia). Phys. Lett.; 41A: No. 4, 323-4(9 Oct 1972).

A rebuttal is made to previous criticism of work on the rest mass of a photon. It is pointed out that the work cited applied to the photon rest mass in a vacuum plasma only and not to all media in general. (J.F.P.)

57314 RENORMALIZABLE GAUGE MODEL OF LEPTON INTERACTIONS. Salam, Abdus (International Centrė for Theoretical Physics, Trieste, Italy); Strathdee, J. Nuovo Cim.; 11A: No. 2, 397-435(21 Sep 1972).

It is known that the spontaneous violation of a gauge symmetry of the second kind results in the appearance not of Goldstone bosons but, rather, of massive gauge particles. The path-integral quantization of these theories is discussed here in general terms.

The primary consideration is that quantities of physical significance, such as matrix elements of the scattering operator or the energy-momentum tensor, should be independent of the gauge in which the quantization rules are formulated. In particular, if it is possible to find one gauge in which the theory is unitary and another in which it is renormalizable, then the gauge-independent quantities must enjoy both these qualities. These ideas are applied to simple models with massive Yang–Mills fields and to a model which unifies the weak and electromagnetic interactions of electron-type leptons. Both these models appear to be unitary and renormalizable. The lepton theory is a relatively economical one. It involves five independent parameters: the electron charge and mass, the mass of the charged intermediate vector boson and the masses of a neutral scalar and a neutral vector boson. (auth)

57315 PION COMPTON SCATTERING AND FIXED POLES. Bhaumik, K.; Ranjan Roy, S.; Dutta-Roy, B. (Saha Inst. of Nuclear Physics, Calcutta). Nuovo Cim.; 11A: No. 2, 344-52 (21 Sep 1972).

From the low-energy theorem and threshold identities for pion Compton scattering, arguments are presented for the presence of a fixed pole in the angular-momentum plane at J = 0 with a residue equal to the Thomson limit. This further leads to predictions for $\Gamma(A_1 \rightarrow \pi\gamma)$ and $\Gamma(A_2 \rightarrow \pi\gamma)$ which agree with available estimates. Also the coupling constant is predicted for $\epsilon(700)$ to two photons which is compared with predictions based on scale invariance. (auth)

57316 OPTIMAL LOWER BOUNDS ON THE HADRONIC CONTRIBUTION TO THE MUON ANOMALOUS MAGNETIC MOMENT. Nenciu, G. (Inst. for Atomic Physics, Bucharest); Raszillier, I. Nuovo Cim.; 11A: No. 2, 319-32(21 Sep 1972).

Rigorous results are derived on the hadronic contribution to the muon anomalous magnetic moment in the form of optimal lower bounds. These bounds depend only on the analytic properties of the pion electromagnetic form factor F(t), its normalization F(0) = 1, and on direct experimental information. The experimental data exploited are, besides lower bounds on the difference between the total cross section of $e^+e^- \rightarrow$ hadrons and the cross section of $e^+e^- \rightarrow \pi^+\pi^-$, alternatively values of F(t) at $t < 0$ (in any situation) and of $|F(t)|$ at $t \geq 4m_\pi^2$ (under certain conditions). It turns out that errors of spacelike data for F(t) can have an extremely strong influence on the order of magnitude of the corresponding bounds. (auth)

57317 PHOTOPRODUCTION AND ELECTROPRODUCTION. Gilman, F. J. (Stanford Univ., Calif.). Phys. Rep.; 4C: No. 3, 95-151(1972).

Various aspects of the electromagnetic interactions of hadrons (strongly interacting particles) are reviewed in these lectures. After a discussion of the properties of the electromagnetic current of the hadrons and the idea of vector meson dominance, the general features of photoproduction cross sections are presented and compared with the very similar behavior of purely strong interaction processes. Given this close similarity in behavior, particular photon induced reactions are then considered in some detail, illustrating the application of theoretical ideas used in treating strong and electromagnetic processes. The particular subjects discussed in some detail are photoproduction of pions at low energy and partial wave analysis, Compton scattering, vector meson photoproduction and tests of the vector dominance model, and photoproduction of charged pions at high energy. Inelastic electron-nucleon scattering is the next principal topic. After a presentation of the kinematics and structure functions of the nucleon, the principal results of the inelastic electron scattering experiments are given together with the evidence for the remarkable scaling behavior of the structure functions. This leads to a presentation of the parton model of point constituents of the nucleon and the interpretation of the experimental results in terms of the properties of the constituent partons. A different view of inelastic electron scattering in terms of strong interaction ideas is presented. This concerns the high energy behavior of the scattering and the application of duality concepts which tie the behavior of nucleon resonance electroproduction to the behavior of the deep inelastic scattering. (auth)

57318 PHOTOPRODUCTION OF THE A_1^0 AXIAL VECTOR MESON. El-Kishen, M. (Cairo Univ.). Acta Phys. Acad. Sci. Hung.; 31: No. 4, 395-9(1972).

The partially conserved vector current hypothesis is used to obtain the energy dependence of total cross sections for A_1^0 production in $\gamma + p \rightarrow A_1^0 + p$ interactions via virtual photon exchange. (J.F.P.)

57319 PROBLEM OF CONTINUATION FROM DEEP-INELASTIC ELECTRON SCATTERING TO DEEP ELECTRON–POSITRON ANNIHILATION. Gatto, R.; Preparata, G. (Univ., Rome). Nucl. Phys.; B47: No. 1, 313-32(1972).

The problem of continuing from deep-inelastic scattering to deep inelastic annihilation is studied. It is shown that by requiring that the total annihilation hadronic cross section behaves like the "point-like" cross section leads to nontrivial Bjorken scaling for the deep inelastic annihilation into one hadron plus anything; which is however not obtainable in general from the deep inelastic scattering. Some considerations on the general problem of crossing are also presented. (auth)

Weak

57320 $\eta \rightarrow \pi\pi\gamma$, $\eta \rightarrow 2\gamma$, $\eta \rightarrow \pi\pi\gamma\gamma$ DECAYS AND FORM FACTOR OF THE VECTOR CURRENT IN K_{l4} DECAY. Solov'ev, V. V.; Terent'ev, M. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 1, 153-61(Jul 1972). (In Russian).

The branching ratio: $\Gamma(\eta \rightarrow \pi\pi\gamma)/\Gamma(\eta \rightarrow 2\gamma)$ and the form factor of the vector current in K_{l4} decay were calculated using the relation obtained previously and SU(3)-symmetry. In the framework of the same assumptions an expression for the amplitude of the process $\gamma\gamma \rightarrow \pi\pi\eta$ and the estimation of the partial width of $\eta \rightarrow \pi\pi\gamma\gamma$ decay were obtained. (auth)

57321 CONTRIBUTION OF INTERMEDIATE STATE $\pi^+\pi^-\gamma$ TO THE ABSORPTIVE PART OF THE DECAY AMPLITUDE $L_L^0 \rightarrow \mu\bar{\mu}$. Dolgov, A. D.; Shifman, M. A.; Shmatikov, M. Zh. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 1, 149-52(Jul 1972). (In Russian).

The contribution of $\pi^+\pi^-\gamma$ intermediate state to the absorptive part of the $K_L \rightarrow \mu\bar{\mu}$ decay amplitude is calculated. No assumption is made on CP invariance. The results obtained considerably differ from those of previous work. (auth)

57322 $K \rightarrow \mu\bar{\mu}$ DECAY AND $2\pi\gamma - 2\mu$ ANOMALOUS INTERACTION. Shifman, M. A.; Shmatikov, M. Zh. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 1, 143-8(Jul 1972). (In Russian).

In connection with the $K_L \rightarrow \mu\bar{\mu}$ decay problem the possibility of existence of $2\pi\gamma - 2\mu$ anomalous interaction is discussed. The anomalous interaction which could compensate the imaginary part of $K_L \rightarrow \mu\bar{\mu}$ decay amplitude is shown to contradict the existing experimental data on the photoproduction of muonic pairs and on the inelastic muon–proton scattering. (auth)

57323 ATOMIC DECAYS OF K_L^0-MESONS. Nemenov, L. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 1, 125-8(Jul 1972). (In Russian).

The probability of K_L^0 decay into neutrino and an atom formed by a pion and μ-meson was calculated. It was shown that relative probability of this process is sensitive to the magnitude $\xi(0) = f_-(0)/f_+(0)$ and weakly dependent on the value of the parameter λ_+. A version of the experiment, where one may observe K_L^0 decay into a neutrino and a mesonic atom is discussed. (auth)

57324 $K_L^0 \rightarrow \mu^+\mu^-$ DECAY AND POSSIBLE ANOMALOUS INTERACTIONS OF MUONS WITH HADRONS. Bogomol'nyi, E. B.; Dolgov, A. D.; Zakharov, V. I.; (and others) (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 1, 129-42(Jul 1972). (In Russian).

A possibility of the existence of an anomalous muon-pion interaction, that could compensate the imaginary part of $K_L^0 \rightarrow \mu^+\mu^-$ decay amplitude, arising due to 2γ-intermediate state is discussed. It is shown that the anomalous $\pi^0 \rightarrow 2\mu$ and $3\pi \rightarrow 2\mu$ interactions do not contradict the existing experimental data on elastic and inelastic scattering of the muon on a nucleon, muonic pair production by pions, and the data on $(g-2)$ for muon. However in the approach considered there arises a great difficulty, connected with a large value of $\mathrm{Re}\, M_{K_L}^{(3\pi)} \rightarrow 2\mu$ which must be compensated with a high accuracy. (auth)

57325 NONLEPTONIC WEAK DECAYS OF MESONS IN A QUARK MODEL OF PARTICLES. Kurdgelaidze, D. F. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 1, 116-18(1972). (In Russian).

In a quark model of particles, the decay of strongly interacting particles along a strong channel may be regarded as the result of strong decays of the component particles of quarks. Due to the unitary SU(3) invariant notation of the corresponding equations this may be achieved. The mathematical development suggests that a rather simple mechanism of nonleptonic weak decays yields at once a qualitatively valid result. For a complete agreement of the numerical values, it is necessary to consider also the influence of the collective interaction on individual quark transitions. (K.S.W.)

57326 SHRINKAGE SINGULARITIES OF AMPLITUDES AND WEAK INTERACTION CROSS-SECTION ASYMPTOTIC. Dolgov, A. D.; Zakharov, V. I.; Okun, L. B. (Inst. of Theoretical and

Experimental Physics, Moscow). Yadern. Fiz.; 15: No. 4, 808-19(Apr 1972). (In Russian).

The so called shrinkage singularities of amplitudes caused by shrinkage of the diffraction peak at asymptotically high energies are discussed. If one demands that the amplitude singularities are not stronger than $t^2 \ln t$ (as it is for neutrino pair exchange diagrams) then the total cross section σ_{tot} cannot increase faster at $s \to \infty$ than $s^{1/2}$. If one demands that shrinkage singularities are absent then σ_{tot} cannot increase as any power of s. All the conclusions are valid, if the dispersion relations with finite number of subtractions exist at $t \leq 0$. (auth)

57327 POSSIBLE CHECK OF THE SCHEME WITH MULTIPLICATIVE LEPTONIC QUANTUM NUMBERS IN HIGH-ENERGY NEUTRINO EXPERIMENTS. Gerstein, S. S.; Folomeshkin, V. N. (Inst. for High Energy Physics, Serpukhov, USSR). Lett. Nuovo Cim.; 5: No. 4, 366-8(23 Sep 1972).

A realistic possibility for checking the scheme with multiplicative leptonic quantum numbers for the decays $\mu^+ \to e^+ + \nu_e + \bar{\nu}_\mu$ and $\mu^+ \to e^+ + \bar{\nu}_e + \nu_\mu$ is given in which decay via the first channel is detected observing the reaction $\nu + e^- \to \mu^- + \nu$ and decay via the second channel is detected observing the reaction $\bar{\nu} + e^- \to \mu^- + \bar{\nu}$. The energy threshold, cross sections, the form of the differential cross sections, and muon energy distributions for the two reactions are found. (J.F.P.)

57328 FIREBALL PRODUCTION IN MUON–NUCLEON INTERACTIONS. Sitte, K. (Univ., Freiburg i. B.). Lett. Nuovo Cim.; 5: No. 4, 338-40(23 Sep 1972).

An attempt is made to deduce further interaction characteristics from the data for interactions of 5-GeV/c accelerator muons and cosmic muons at energies of 10 to 100 GeV with nucleons. The consequences of fireball production are discussed according to two models. The Lorentz factor and the interaction inelasticity are treated. It is shown that a model of nuon–nucleon interactions assuming absorption by the nucleon of the transferred energy and subsequent isotropic decay of this excited body by the emission of a fireball provides a fair description of the data. (J.F.P.)

57329 $\Delta I = 5/2$ CONTRIBUTIONS IN $K \to 2\pi$ DECAYS AND $(\delta_0 - \delta_2)$ S-WAVE $\pi - \pi$ PHASE SHIFTS. Sarker, A. Q. (Queen Mary Coll., London). Phys. Lett.; 41B: No. 2, 157-9(18 Sep 1972).

The experimental decay rates for $K \to 2\pi$(CP conserving) are analyzed under general conditions. The $\Delta I = 5/2$ part of the amplitudes is then calculated in a model to predict $|(\delta_0 - \delta_2)|$, the S-wave $\pi - \pi$ phase shifts to be $50.8^\circ \pm {}^{6.8^\circ}_{7.3^\circ}$ at $\sqrt{s} = m_K$, compared to $55.5^\circ \pm 5.1^\circ$, obtained from the $\pi - \pi$ scattering cross sections. (auth)

57330 APPLICATION OF CURRENT ALGEBRA TO $K \to 2\pi$ DECAYS AND THE DECAY $K^+ \to \pi^+\gamma\gamma$. Trofimenkoff, N. N. (Univ. of Calgary, Can.). Phys. Lett.; 41B: No. 2, 160-2(18 Sep 1972).

Current algebra and PCAC are applied to $K \to 2\pi$ decays with the nonleptonic weak interaction allowed to contain both $\Delta I = 1/2$ and $\Delta I = 3/2$ components. Implications of a recent experiment on $K^+ \to \pi^+\gamma\gamma$ are discussed. (auth)

57331 HIGHER-ORDER CORRECTIONS TO LEPTONIC PROCESSES AND THE RENORMALIZATION OF WEINBERG'S THEORY OF WEAK INTERACTIONS IN THE UNITARY GAUGE. Lee, S. Y. (Univ. of California, San Diego, La Jolla). Phys. Rev., D; 6: No. 6, 1701-17(15 Sep 1972).

Higher-order corrections to the leptonic processes such as muon decay and neutrino–lepton scattering are investigated in order to study the problems associated with the renormalization of the Weinberg theory of weak interactions in the unitary gauge. It is shown that there are definite ways to carry out the renormalization programs and the residual divergences (quadratic as well as logarithmic) cancel out systematically. As a result it is found that the higher-order corrections to these processes and the neutrino charge radius are all finite. As a by-product, it is found that the logarithmic residual divergences in the elastic ν-ν scattering also cancel out. (auth)

57332 FINITE HIGHER-ORDER WEAK AND ELECTROMAGNETIC CORRECTIONS TO THE STRANGENESS-CONSERVING HADRONIC β DECAY IN WEINBERG'S THEORY OF WEAK INTERACTIONS. Lee, S. Y. (Univ. of California, San Diego, La Jolla). Phys. Rev., D; 6: No. 6, 1803-7(15 Sep 1972).

Second-order weak and electromagnetic corrections to the strangeness-conserving hadronic β decay are studied in Weinberg's theory of weak interactions. It provides a test of the renormalizability of the theory in the unitary gauge and of the validity of hadronic neutral current recently introduced by Weinberg. It is shown that after renormalization all corrections are finite. (auth)

57333 WEAK INTERACTION IN THE FORMATION OF ELECTRON–POSITRON AND MUON PAIRS DURING COLLISIONS OF ANTIPROTONS WITH PROTONS. Guliev, N. A.; Dzhafarov, I. G. (Inst. of Physics, Baku). Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 4, 91-9(1971). (In Russian).

Weak interactions in lepton formation processes during proton–antiproton collisions were investigated. The effects obtained should provide additional information on the validity of the Tanikawa–Watanabe–Shabalin theory. Hadron-lepton interactions, differential cross sections, the angular distribution of leptons (in a laboratory system and in an inertia system), and the total cross sections for the reactions involved were developed. (K.S.W.)

57334 RE-EVALUATION OF THE RELATIVE DECAY RATE OF LONG-LIVED AND SHORT-LIVED NEUTRAL KAONS INTO TWO NEUTRAL PIONS. Heeren, U. (Technische Hochschule, Aachen). Nuovo Cim.; 11A: No. 2, 305-18(21 Sep 1972).

Some time ago the CP-violating decay $K_L^0 \to \pi^0\pi^0$ was discovered by a CERN–RHEL–Aachen group, using a multiplate spark chamber arrangement near a K_L^0 beam, derived from the CERN proton synchrotron. These data were reanalyzed performing a least-squares fit to each event. The average errors of directions and energies of the detected photons were experimentally determined on samples of 4-shower and 6-shower events. A normalization on regenerated $K_S^0 \to 2\pi^0$ decays was used. The value of $|\eta_{00}| = |A(K_L^0 \to 2\pi^0)/A(K_S^0 \to 2\pi^0)| = (2.4 \pm 0.5) \cdot 10^{-3}$ is consistent with T violation and CPT conservation in $K_L^0 \to 2\pi$ decay and with the existence of a superweak interaction. (auth)

57335 LEPTON–NUCLEON SCATTERING SUM RULES FROM TRIPLET QUARK MODEL LIGHT-CONE ALGEBRA OF CURRENTS. Mohapatra, R. N.; Weisz, P. H. (Univ. of Maryland, College Park). Nuovo Cim.; 11A: No. 2, 367-79(21 Sep 1972).

Using Fritzsch–Gell-Mann light-cone algebra of currents, sum rules and inequalities involving strangeness-changing and strangeness-conserving scaling functions in ν-N and $\bar{\nu}$-N scattering and in e-N scattering were derived. Some of these are found to depend on the charges of consistent quarks and hence distinguish between various models. (auth)

Strong (General)

Refer also to abstract 57224.

57336 (CERN-72-10, pp 275-84) METHODS OF ANALYSIS: BROAD RESONANCES (CUTS AND RATES). Donald, R. A. (Univ. of Liverpool).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

Various methods that have been used for studying a suspected enhancement from experimental data are briefly discussed: (1) A smooth freehand background is drawn, a Breit–Wigner is superimposed, and a cross section and significance are computed; (2) A fit to a phase space background plus a Breit–Wigner is made by minimizing χ^2 on the appropriate distribution; a fit is made to several distributions simultaneously by minimizing the χ^2 computed by summing the χ^2 from the separate distributions; and (4) A maximum likelihood fit is made to the distribution of events in the appropriate multidimensional space. Two kinds of cuts are then discussed: simple cuts, which exploit a knowledge of the decay mode of the resonance, and cuts which exploit a supposed understanding of the production mechanism. (L.B.S.)

57337 (RPP/T-20) PHENOMENOLOGY OF DIFFRACTIVE REACTIONS. Kane, G. L. (Rutherford High Energy Lab., Chilton (England)). Jun 1972. 65p. Dep. NTIS (U. S. Sales Only).

Lectures on diffractive reactions are presented with very close attention to the detailed features of relevant experimental data. It is argued that traditional views are not adequate to describe the actual data at energies where it is currently available. A model is presented that is capable of describing in detail most of the diffractive data. (J.F.P.)

57338 (UH-511-123-72) COMMENTS ON A LIMITING TEMPERATURE IN HADRON PHYSICS. Tuan, S. F. (Hawaii Univ., Honolulu. Dept. of Physics and Astronomy). Apr 1972. Contract AT(04-3)-511. 15p. Dep. NTIS.

It was pointed out by Yang that if hadron physics were indeed governed by a limiting temperature $T_0 \sim 160$ MeV, then such a far-reaching conclusion would constitute no less than the establishment of a fourth law of thermodynamics. The basis for the limiting temperature concept is commented on briefly but critically with particular emphasis on its implications for the production of massive exotic hadron states. (auth)

57339 IDEA ON THE ORIGIN OF THE HIERARCHY: TWO-BODY AMPLITUDE = DIFFRACTION + (1/root) PERIPHERAL

+ ... . Ingraham, R. L. (New Mexico State Univ., Las Cruces). Lett. Nuovo Cim.; 5: No. 4, 315-18(23 Sep 1972).

The idea is considered that the whole impact parameter representation amplitude for two-body hadronic data at high energies which is a sum of terms $f = f_p + F_R$ is of pure diffractive form, but in a shifted impact parameter $b + \Delta b$, where b corresponds to a constant shift Δl in angular momentum. The magnitude and sign of the shift Δl is found by comparing the known relative sizes of f_P and f_R at high energies, and an attempt is made to interpret this value. (J.F.P.)

57340 ANALYTIC PROPERTIES OF SYMMETRY BREAKING IN THE σ MODEL. Carruthers, P. (Cornell Univ., Ithaca, N. Y.); Haymaker, Richard W. Phys. Rev., D; 6: No. 6, 1528-34 (15 Sep 1972).

In the tree approximation to the σ model the scalar-field vacuum expectation values are multi-valued functions of the symmetry-breaking parameters. The implications of this for the existence of a radius of convergence for perturbation expansions about the symmetry limit are analyzed. Special attention is given to the structure of the solutions as a function of the mass parameter in the original Lagrangian. Although this parameter is numerically small in a fit to data, its precise value determines whether the underlying symmetry-limit solution can exhibit spontaneous breakdown of the symmetry. The mathematical structure of the solutions is surprisingly similar to that of the mean-field theory in statistical mechanics. It is suggested that the real world may be near a "phase transition" and that new methods in statistical mechanics could be exploited to analyze chiral dynamics, with results more general than found in the particular model considered here. (auth)

57341 SOLUTIONS OF A NONLINEAR INTEGRAL EQUATION FOR HIGH-ENERGY SCATTERING. II. NUMERICAL SOLUTIONS. McDaniel, H. (Univ. of Illinois, Chicago); Uretsky, J.; Warnock, R. L. Phys. Rev., D; 6: No. 6, 1600-11(15 Sep 1972).

Solutions of the Ball—Zachariasen equation for high-energy scattering are calculated numerically. For small values of the parameter c, which measures the strength of particle production, the solutions coincide with those obtained in the existence proof of paper I. When $c\sigma_{el}$(σ_{el} = elastic cross section) is much smaller than the physical value, the solutions are obtained successfully by either plain iteration or Newton—Kantorovich iteration, but they disagree qualitatively with experiment. A continuation to larger c is attempted by using the result of a successful iteration as the starting point for an iteration with slightly larger c. The continuation proceeds only a short distance before coming to a halt, because of a singularity of the Fréchet derivative of the nonlinear integral operator. The singularity is circumvented by an excursion into the complex c plane. On return to the real axis the solutions are complex, however, which is not allowed physically. A proposed approximate solution of Ball and Zachariasen, quite different from those of paper I, is also investigated. Plain or Newton—Kantorovich iteration starting with this function fails to converge. The failure is explained again in terms of a nearby singularity of the Fréchet derivative. The singularity makes it difficult to decide whether the Ball—Zachariasen function is close to a true solution. (auth)

57342 SOLUTIONS OF A NONLINEAR INTEGRAL EQUATION FOR HIGH-ENERGY SCATTERING. I. AN EXISTENCE THEOREM. McDaniel, H. (Univ. of Illinois, Chicago); Uretsky, J.; Warnock, R. L. Phys. Rev., D; 6: No. 6, 1588-99(15 Sep 1972).

Ball and Zachariasen have proposed a model of high-energy diffraction scattering, which entails nonshrinking diffraction peaks. The model has some resemblance to the multiperipheral model, in that it emphasizes s-channel unitarity with a simple factored form of production amplitudes. It leads to an integral equation for the elastic amplitude which is relatively simple in appearance. The equation is analyzed here with the help of methods which may also be useful in the study of more realistic high-energy models. The Hankel transform of the original equation is studied as a nonlinear equation in a certain Banach space. Existence of an infinite class of solutions is proved by means of the contraction mapping principle. These solutions are constructed by iteration for small values of a parameter c, which measures the strength of particle production. The range of allowed values for the product of c and the elastic cross section does not include the physical value. One can try, however, to continue the solutions to the physical value, since they are analytic in c. (auth)

57343 GAUGE INVARIANCE AND WARD IDENTITIES IN A MASSIVE-VECTOR-MESON MODEL. Lowenstein, J. H. (Univ. of Pittsburgh); Schroer, B. Phys. Rev., D; 6: No. 6, 1553-71 (15 Sep 1972).

Normal-product techniques are applied to the study of gauge invariance in a massive-vector-meson model in renormalized perturbation theory. Composite fields are defined which are invariant under a one-parameter family of covariant gauge transformations. Ward identities are derived for Green's functions involving an arbitrary number of vector and axial-vector currents. The lack of lowest-order radiative corrections to the triangle anomaly of the axial-vector Ward identity is verified using Bogoliubov—Parasiuk—Hepp—Zimmermann methods. (auth)

57344 GENERAL CONNECTIONS BETWEEN INCLUSIVE AND EXCLUSIVE PROCESSES AND CLUSTER DECOMPOSITION. Shei, Sun-sheng; Yan, Tung-mow (Cornell Univ., Ithaca, N. Y.). Phys. Rev., D; 6: No. 6, 1744-56(15 Sep 1972).

General connections between exclusive and inclusive cross sections are studied by the generating-functional technique. Exclusive cross sections, inclusive cross sections, and correlation functions appear as coefficients of different Taylor series expansions of the same generating functional. Also studied are the connections between semi-inclusive processes where all charged particles in an event are observed and genuine inclusive processes with only some of the charged particles observed. No information on neutral particles enter in these connections for semi-inclusive processes. In special cases our results reproduce several seemingly unrelated aspects of inclusive processes treated by Mueller, Predazzi, and Veneziano and by Campbell and Chang. The approach yields additional constraints and sum rules for inclusive cross sections. It is established that an infinite number of correlation functions are needed; correlation in the pionization region necessarily exists if the multiplicity increases with energy and the transverse momenta of the final particles are limited. A brief comparison between exclusive and inclusive cluster decomposition is given. The question of diffraction dissociation is also very briefly discussed. (auth)

57345 TEMPERATURE MAXIMUM OF THE EARLY (HADRON) UNIVERSE. Stauffer, D. (Univ. of Illinois, Urbana). Phys. Rev., D; 6: No. 6, 1797-8(15 Sep 1972).

For nonzero baryon number, the theory of Huang and Weinberg discussed an unrealistic limit for the baryonic chemical potential. In a more realistic limit, the temperature approaches Hagedorn's $T_0 \simeq 2 \times 10^{12}$ K much more closely than previously estimated ($1 - T/T_0 \sim 10^{-16}$ instead of 10^{-8}). (auth)

57346 SYMMETRIES AND NONSYMMETRIES OF THE RELATIVISTIC QUARK MODEL. Rosner, J. L. (Univ. of Minnesota, Minneapolis). Phys. Rev., D; 6: No. 6, 1781-96(15 Sep 1972).

The dynamical successes of the relativistic quark model are separated from those due to symmetry arguments. Particular attention is paid to the example of the $q\bar{q}$, L = 1 meson decays. A relativistically invariant coplanar form of U(3) ⊗ U(3) is found to explain all predictions of the relativistic quark model for decays within a given multiplet except (a) the absence of spin—orbit effects and (b) relations between different partial waves, e.g., in $B \to \omega\pi$. The coplanar symmetry is expected to be as good as the quark-model classification scheme itself. It preserves most of the better predictions of $SU(6)_W$, while avoiding some that are questionable. Some of the "good" predictions preserved are $\Gamma(A_2 \to \rho\pi)/\Gamma(A_2 \to K\bar{K}) = 6$, $(f/d)_{8(5/2^-)\to 8(1/2^+)8(0^-)} = -{}^1/_3$, and $(f/d_{8(5/2^+)\to 8(1/2^+)8(0^-)} = {}^2/_3$. Questionable predictions of $SU(6)_W$ avoided by the coplanar symmetry include the selection rules $A_1 \not\to \rho\ (\lambda = 0)\pi$, $B \not\to \omega(\lambda = 1)\pi$. A model of hadron decays which assumes them to occur via production of a $^3P_0$ $q\bar{q}$ pair is consistent with (but more specific than) the coplanar symmetry. (auth)

57347 DUAL-RESONANCE MODEL OF VECTOR CURRENTS: A REPRESENTATION OF CURRENT ALGEBRA. Kikkawa, K.; Sakita, B. (City Coll., New York). Phys. Rev., D; 6: No. 6, 1734-43(15 Sep 1972).

A model of hadronic vector currents is constructed. It satisfies the following conditions: (i) factorization, (ii) duality, (iii) generalized Ward—Takahashi identity, and (iv) absence of moving singularities. The model consists of the single-photon-emission vertex and the double-photon-emission vertex (seagull term). (auth)

57348 SPECTRUM OF PHYSICAL STATES IN A DUAL-RESONANCE MODEL. Lee, Huan (Northeastern Univ., Boston); Leung, Y. C. Phys. Rev., D; 6: No. 6, 1686-93(15 Sep 1972).

The dual-resonance model entails an exponentially growing resonance spectrum for the hadrons. It is well known that not all the states which achieve the factorization are physical ones; there are spurious and ghost states among them. A general formula is given for counting the ghost states at any given mass value and also an asymptotic expression for the ghost spectrum. The Virasoro model, in which the leading trajectory intercept is unity, is not considered here. A method for constructing the subspace of real states, which is orthogonal to the space of spurious states, is also given. After removing the ghost states from the real states, the remaining ones are taken as physical states, which then constitute the resonance spectrum. Implications of this resonance spectrum in the statistical approach are briefly discussed. (auth)

57349 DUALITY CONSTRAINTS ON INCLUSIVE REACTIONS. II. THE ROLE OF THE HARARI–FREUND CONJECTURE. Einhorn, M. B. (Univ. of California, Berkeley); Green, M. B.; Virasoro, M. A. Phys. Rev., D; 6: No. 6, 1675-86(15 Sep 1972).

A scheme is presented for the generalization of the two-component theory of Harari and Freund to multiparticle amplitudes and, in particular, to inclusive reactions. The scheme is based on duality and borrows the terminology of dual perturbation theory but the generalizations are not restricted to any specific model. A criterion is obtained for the absence of secondary (nonscaling) Regge contributions in inclusive reactions. It is shown how inclusive reactions may approach their limiting values from below, in contrast to total cross sections which always have positive secondary contributions. The scheme suggests a novel interpretation of diffraction dissociation. (auth)

57350 SPECTRUM-GENERATING ALGEBRA AND NO-GHOST THEOREM FOR THE DUAL MODEL. Brower, Richard C. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 6: No. 6, 1655-62(15 Sep 1972).

The dual model is generally factorized using Lorentz oscillators a_n^μ with ghost (or negative-norm) states arising from the indefinite metric ($[a_m^0, a_n^{0\dagger}] = -1$). Here all ghost states are proven to decouple for unit Regge intercept ($\alpha_0 = 1$) as a consequence of the Virasoro gauges (L_n). By reformulating vertices in light-cone variables and exploiting the local commutators (for Q^μ, P^μ) on the Koba–Nielson circle, the spectrum-generating algebra (A_n^i, $A_n^{(+)}$) is found that commutes with all the gauges L_n. All physical states are explicitly constructed. The no-ghost theorem follows from the remarkable isomorphism of the transverse generators A_n^i ($i = 1,2$) of Del Giudice, Di Vecchia, and Fubini to the original oscillators $\sqrt{n}\, a_n^i$, $[A_n^i, A_m^j] = n\delta_{ij}\delta_{n+m,0}$, and the isomorphism (up to c numbers) of the longitudinal generators $A_n^{(+)}$ with the conformal group generators L_1, $[A_n^{(+)}, A_m^{(+)}] = (n-m)A_{n+m}^{(+)} + 2n^3\delta_{n+m,0}$. Increasing the number of spatial oscillators (a_n^i, $i = 1, \ldots, D-1$), one observes a critical dimension $D = 26$. For $D > 26$ ghosts appear, for $D < 26$ there are no ghosts, and $A_1^{(+)}$ gives the null states postulated by Brower and Thorn. But for $D = 26$, all $A_n^{(+)}$ correspond to null states, so that the second-order Pomeranchukon is precisely a Regge pole ($\alpha_P = \frac{1}{2}\alpha' s + 2$) as proposed by Lovelace. (auth)

57351 EXACT NONPERTURBATIVE SOLUTION OF A NONLINEAR FERMION-FIELD EQUATION OF MOTION. van der Spuy, E. (Atomic Energy Board, Pelindaba, South Africa). Phys. Rev., D; 6: No. 6, 1543-53(15 Sep 1972).

An infinite-component free neutral fermion field ψ^h, of type ($\frac{1}{2}$,j) or (j,$\frac{1}{2}$), carrying compounds lying on a Regge trajectory, as a nonperturbative solution of the nonlinear fermion-field equation of motion introduced in a previous paper is constructed. The compounds are considered to be strongly interacting. It can be shown that the Reggeization and instability of the compounds lead to a propagator which is much less singular than a classical field with the same spin components but without these features. The solution can be tested in two complementary ways in the equation of motion. First, by applying a compounding technique developed in a previous paper, the corresponding spectral-function equation can be discussed in the limit of high mass-squared values, and its convergence and the necessary scale factor can be determined. The scale factor is related to the role of the effective line width in the scattering theory involved in this technique. Second, by applying the Wick normal-ordering theorem to the infinite-component free-field operators in the equation of motion, an exact nonlinear equation of motion for the field propagator is derived, effectively as a spectral-function equation. A sufficient and exact condition for the existence of this solution is derived and is in fact a linear integral equation for the momentum transform of the propagator. The convergence of this condition of solution is discussed. The condition for the existence of the nonperturbative solution ψ^h is formally exactly the same as that for the existence of the lepton solution ψ^1 and is related to the γ^5 invariance of the primitive field equation of motion (effectively the lepton-field equation of motion), and can be put in a form showing a weak coupling of the two solutions each to a corresponding appropriate massless-fermion propagator and a massive-boson propagator. This form of the exact condition of solution also leads to an interpretation of the lepton solution ψ^1, discussed in a previous paper, in terms of a single free massless spin-$\frac{1}{2}$ observable fermion field ψ^ν, completely satisfying unitarity. ψ^ν couples weakly and effectively nonlocally to ψ^1 which has an indefinite metric, and to a massive boson field, both of which are not observable, at least not in the present form of the solution where isosymmetry is not introduced and broken. In this form the Hilbert spaces corresponding to ψ^ν and ψ^h are completely orthogonal. (auth)

57352 COMMENT ON SUMMING THE LEADING TERMS IN THE VECTOR-GLUON MODEL. Marques, G. C.; Woo, C. H. (Univ., Sao Paulo, Brazil). Phys. Rev., D; 6: No. 6, 1811-13 (15 Sep 1972).

Although the procedure of summing the leading terms gives, in the neutral vector-gluon model, asymptotically damped charge form factors, on-shell and off-shell, when applied to other off-shell form factors the procedure gives results not fulfilling gauge invariance. (auth)

57353 EXTENDED HADRONS, SCALING VARIABLES, AND THE POINCARE GROUP. Guersey, F.; Orfanidis, S. (Yale Univ., New Haven). Contract AT(30-1)-2726. Nuovo Cim.; 11A: No. 2, 225-78(21 Sep 1972).

A convenient description of hadron states is presented by means of minimum-uncertainty wave packets in transverse internal position or momentum operators which can be defined in the infinite-momentum frame (IMF) basis for the Poincaré group. The center of mass of the hadron is described either by its momentum or its IMF position operator, while its internal structure is fixed by taking coherent states symmetrical in the internal co-ordinates. The resulting physical picture of hadrons as extended objects with a stable structure agrees with Yang's model of droplets with optimum universal size. The reduction of products of states in the infinite-momentum frame with respect to the basis introduces Clebsch–Gordan coefficients which asymptotically depend only on certain scaling variables, thus allowing one to trace their emergence to a general framework. These are precisely the scaling variables connected with different high energy regions where limiting behavior patterns for hadronic cross sections, like diffraction, Bjorken scaling, Feynman scaling and limiting fragmentation are known to occur.

57354 MULTIPERIPHERAL DYNAMICS BEYOOD MODELS. Bassetto, A. (CERN, Geneva): Sertorio, L.; Toller, M. Nuovo Cim.; 11A: No. 2, 447-75(21 Sep 1972).

The physical content and the formal apparatus of multiperipheralism is examined showing that their essence is an upper bound with suitable decrease and factorization properties. From this bound, exact factorized representation for the production amplitudes is derived leading to a rigorous multiperipheral integral equation. The exact formulas for the total cross section and the n-particle inclusive distributions are given. The multiperipheral models studied so far appear as possible approximations of the equations. (auth)

57355 THEORY OF ELEMENTARY COUPLINGS. I. Wellner, Marcel (Syracuse Univ., N. Y.). Ann. Phys. (N. Y.); 73: No. 1, 180-209(Sep 1972).

Some recent attempts at constructing a detailed dynamical theory ("compensation theory") of strong interactions are revised, extended, and systematized. It is hoped that this, which aims at being self-contained, may serve as an introduction to the subject. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 57237 and 57416.

57356 (CERN-72-10) SYMPOSIUM ON NUCLEON–ANTINUCLEON ANNIHILATIONS, CHEXBRES, SWITZERLAND, 27–29 MARCH 1972. Montanet, L. (ed.) (European Organization for Nuclear Research, Geneva (Switzerland)). 15 Jun 1972. 337p. (CONF-720329).

Twenty papers are included; a separate abstract was prepared for each paper. (L.B.S.)

For abstracts of individual papers see: 57231–57237, 57253, 57336, 57357–57366, and 57373.

57357 (CERN-72-10, pp 113-34) MODELS FOR NUCLEON–ANTINUCLEON ANNIHILATIONS. Vandermeulen, J. (Univ., Liege).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

A partial review is given on nucleon–antinucleon annihilations that concentrates on a few general features of phenomenological character and describes models of statistical type and related, which attempt at systematizing the properties such as the structure of the multiplicity distribution, the magnitude and energy variation of the multipion cross sections. (L.B.S.)

57358 (CERN-72-10, pp 135-59) GROSS FEATURES OF THE NUCLEON–ANTINUCLEON ANNIHILATION PROCESS. Muirhead, H. (Univ. of Liverpool).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

Various features of the nucleon–antinucleon annihilation interactions are discussed: total cross sections, isospin dependence of the total cross section, G-parity dependence, energy dependence, and resonance production. (L.B.S.)

57359 (CERN-72-10, pp 161-80) INITIAL ANGULAR MOMENTUM STATE IN $\bar{p}p$ ANNIHILATION AT REST. Bizzarri, R. (Univ., Rome).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

A review is given of various studies made in search for evidence for the presence of initial states with orbital angular momentum greater than zero in $\bar{p}p$ annihilations. From the discussion the following conclusions are given: No quantitative statement can be made on the relative importance of initial P states in $\bar{p}p$ annihilations at rest. Annihilations in flight indicate that P-wave annihilation into $K_1^0K_1^0$ is inhibited while annihilation into $\pi\pi$ is enhanced and might suggest a P-wave contamination ~10%. The observation of the final state $K_1^0K_1^0$ n from $\bar{p}d$ annihilations at rest indicates on the contrary that the depression of the $K^0\bar{K}^0$ final state is not so important and suggests a P-wave contamination smaller than 4%. The successes obtained in the analysis of various final states on the assumption of s-wave annihilation would be difficult to reconcile with a P-wave contribution larger than ~5%. (L.B.S.)

57360 (CERN–72-10, pp 181-207) MODELS FOR ANALYSIS OF ANNIHILATIONS. Ghesquiere, C. (College de France, Paris).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

A brief review is first given of the main trends of previous analysis of antiproton annihilation. The various models used for analysis are then discussed in terms of some definite applications, and some of the problems encountered when applying the models are pointed out. The model of final-state interaction, the three-body problem, and duality and the Veneziano model are treated. It is concluded that dual models may be the more promising, as they permit connection with many crossed channels. (L.B.S.)

57361 (CERN–72-10, pp 213-26) ANGULAR MOMENTUM ANALYSIS, ZEMACH/HELICITY. Lillestoel, E. (Univ. of Bergen).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

The results of a previous analysis of the data from the $\bar{p}p \rightarrow \omega\pi^+\pi^-$ reaction are checked by using a different approach and analyzing the data in terms of helicity amplitudes. A maximum likelihood fit is used, working in the full 5π final state. A brief introduction is first given to the Zemach tensors and the helicity amplitudes. A method of angular selections is also discussed. (L.B.S.)

57362 (CERN-72-10, pp 229-33) TWO ELEMENTARY METHODS OF ANALYZING $\bar{N}N \rightarrow 3\pi$. Bjoerneboe, Jens (Univ. of Copenhagen).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

The methods of isospin analysis and grand angular momentum analysis, which may be useful to analyze the reactions $\bar{p}p \rightarrow \pi^+\pi^0\pi^-$ and $\bar{p}n \rightarrow \pi^+\pi^-\pi^-$, are briefly described. (L.B.S.)

57363 (CERN-72-10, pp 235-9) ANNIHILATION REACTION $\bar{p}p \rightarrow 3\pi^+3\pi^-$ WITH AN ISOBARIC AMPLITUDE. Nellen, Bernd (Univ., Bonn).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

A good overall description of the experimental data for the reaction $p\bar{p} \rightarrow 3\pi^+3\pi^-$ is achieved with an isobaric amplitude A_8. (auth)

57364 (CERN-72-10, pp 241-52) ANALYSIS OF THE REACTION $\bar{p}p \rightarrow 2\pi^+2\pi^-\pi^0$ AT REST USING A SIMPLIFIED VERSION OF THE ISOBAR MODEL. Gurtu, A. (CERN, Geneva).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

The application of the isobar model to the reactions $\bar{p}p \rightarrow 2\pi^+2\pi^-\pi^0$ at rest is described. Modest agreement with experiment is obtained. (L.B.S.)

57365 (CERN-72-10, pp 285-300) ANALYSIS OF NARROW EFFECTS IN $\bar{p}p$ ANNIHILATIONS. Defoix, C. (College de France, Paris).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

Some methods of analysis of narrow effects in rather high-multiplicity meson final states are briefly described. Problems met in the detection of the possible $\delta\pi$ decay of the D^0 are first discussed. The method of separating two competing channels to minimize the reflections due to the undesirable one is then discussed. The method of localizing chains of decay through successive narrow objects is treated. Finally, the isolation of the channel of interest from a sample with reduction of the number of bodies in the final state is discussed. (L.B.S.)

57366 (CERN–72-10, pp 319-29) ANTIPROTON–NUCLEON ANNIHILATIONS AT LOW ENERGIES. Kalogeropoulos, T. E. (Syracuse Univ., N. Y.).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

Some recent experimental results on the $\bar{p}p$ S-capture and $\bar{p}d$ annihilations at rest are first discussed. A summary is then given of various questions considered to be important for future experimental exploration in antinucleon physics. (L.B.S.)

57367 (DEMO–72/7) LINEAR REGGE TRAJECTORIES WITH A LEFT HAND CUT. Antoniou, N. G.; Georgalas, C. G.; Kouris, C. B. (Democritus Nuclear Research Center, Athens (Greece)). Jun 1972. 20p. Dep. NTIS (U. S. Sales Only).

The properties of boson Regge trajectories $\alpha(s)$ with a left hand cut for $s < 0$ are studied, with the following assumptions: (a) Re $\alpha(s)$ is linear in the physical regions of the s and t channels. (b) The imaginary part is asymptotically smaller than the real part. (c) At $s = 0$, $\alpha(s)$ has a branch point due to the existence of a Regge cut $\alpha_c(s)$ in the angular momentum plane, with $\alpha_c(0) = \alpha(0)$. The branch point is attributed to the collision of the physical pole $\alpha(s)$ with a second sheet pole $\tilde{\alpha}(s)$, at $s = 0$. (d) The function $\alpha(s)$ is analytic in the s plane. Under these assumptions the imaginary part for each boson trajectory is obtained in terms of a parameter A and a parameter-free universal function determined by solving an integral equation numerically. The parameter A is determined by requiring that the first meson of each trajectory have the observed width. The model gives imaginary parts increasing almost linearly with s for large $|s|$. The widths of the recurrences increase linearly with their mass. The results support exchange degeneracy ρ–f, K^*–K_N, ω–A_2. The imaginary part, for $s < 0$, is compared to the phenomenological results of others. (auth)

57368 (ORO–3992-99) TRUNCATED STATISTICAL BOOTSTRAP EQUATION. Chiu, Charles B. (Texas Univ., Austin. Center for Particle Theory). Sep 1972. Contract AT(40-1)-3992. 47p. (CPT–153). Dep. NTIS.

An extension of the thermodynamic bootstrap model in which the volume parameter depends on the number of sub-fireballs N is proposed. Based on the conventional three-point resonance coupling, it is suggested as a first approximation that those $N \geq 3$ terms should be dropped. One can then describe the many particle system in terms of two-body interaction dynamics. Three kernels for the bootstrap integral equation are considered, with an analytic solution presented for one of them. Properties of the fireball deduced from the truncated equation are presented. Most properties are insensitive to the difference of the kernels used. The observed average pion multiplicity in $\bar{p}p$ annihilation at rest is reproduced with the two-body interaction range $r = 1.22\,\lambda\!\!\!^{-}_{\pi}$. The dependence of the average pion multiplicity on the fireball mass m is given by $\langle n_\pi \rangle \approx 2.0m + 0.62$. This slope agrees with the empirical value found in the Nova model. For a fireball with mass less than 2 GeV/c, the truncated equation predicts that over 50% events have successive emission of pions at each step along the decay chain. This provides some justification for the random walk assumption for Nova decay. The momentum distribution of pions, neglecting the fireball recoil effect, in the small p region has the form $d\sigma/dp^2 \sim \exp(-p^2/K^2)$ with $K \approx 0.23$ GeV. Finally with the "duality coupling scheme", fireballs are associated with nonexotic states dual to the cross channel exchange. The weak version of the strong central absorption prescription for two-body scattering is in accord with this scheme. This scheme also explains the presence of the Ericson fluctuations in the nonexotic elastic differential cross sections, but not in the exotic ones. (auth)

57369 CHARGE VARIABLES FOR DESCRIBING SYSTEMS CONSISTING OF PARTICLES AND ANTIPARTICLES. Kerbikov, B. O.; Mandel'tsveig, V. B.; Shapiro, I. S. Zh. Eksp. Teor. Fiz.; 62: No. 6, 2013-18(Jun 1972). (In Russian).

A method for determining the wave function of a system consisting of several nonrelativistic nucleons and antinucleons is proposed in which the wave function satisfies the interchange symmetry condition. A formula which expresses G-parity in terms of the characteristics of the Young charge scheme is derived for many-particle systems with zero baryon charge. (auth)

57370 PION FORM FACTOR ANALYTICITY AND MEAN-SQUARED ELECTROMAGNETIC RADIUS. Stoyanov, S. S.; Shcherbin, Yu. P. Vestn. Leningrad. Univ., No. 22, Fiz., Khim.; No. 4, 147-9(Nov 1971). (In Russian).

The electromagnetic pion radius was calculated by means of the dispersion techniques which were found to be the most suitable ones for analysis of the experimental situation. By interpolating the experimental data in the spacelike region of the momentum transfer squared by the formula of the Clementel–Villi type a pion radius $r_\pi \leq 1.3$ F is obtained. (auth)

57371 BROKEN SCALE INVARIANCE, CURRENT ALGEBRA, AND MASSIVE GRAVITATION. I. GENERAL FORMULATION. Nath, P.; Arnowitt, R.; Friedman, M. H. (Northeastern Univ., Boston). Phys. Rev., D; 6: No. 6, 1572-87(15 Sep 1972).

A general analysis is given of the interaction of mesons of $J^P = 0^\pm$, $1^\pm$, and 2^+ obeying the principles of broken scale invariance in the tree and seagull approximations. In analogy with current algebra, where one assumes that the vector and axial-vector currents are dominated by $J^P = 1^\pm$ and $0^\pm$ mesons in a field-current identity, we assume that the stress tensor $\Theta^{\mu\nu}$ is dominated mainly by the 2^+ and 0^+ f, f′, σ, and σ′ mesons in a field-stress-tensor identity. A consistent formalism is seen to require also certain nonpole f-meson mass terms in $\Theta^{\mu\nu}$. With the usual smoothness conditions, the dynamics can be conveniently characterized by introducing an effective Lagrangian. The conservation law $\partial_\nu \Theta^{\mu\nu} = 0$ and the Poincaré-group conditions then imply that (i) the $f^i_{\mu\nu}(x)$ fields ($i = 1, 2, \ldots$) of the f, f′, etc., mesons couple with all other "matter fields" (e.g., $J^P = 0^\pm$, $1^\pm$ mesons) by making the usual matter Lagrangian of current algebra "generally covariant" by replacing the Lorentz metric $\eta_{\mu\nu}$ by a "metric" formed from $g_{\mu\nu\alpha} \equiv \eta_{\mu\nu} + \Sigma_i \lambda_{\alpha i} f^i_{\mu\nu}$ ($\alpha = 1, 2, \ldots$). (ii) The kinetic-energy part of the f-meson self-couplings must have the form of Einstein Lagrangians formed using the $g_{\mu\nu\alpha}$, e.g., $\sqrt{-g_\alpha}\, g^{\mu\nu}_\alpha R_{\mu\nu\alpha}$ where $R_{\mu\nu}$ is the contracted curvature tensor. (iii) Improvement for the spin-zero parts of the stress tensor is obtained by including "curvature" couplings, e.g., $\pi^2\sqrt{-g_\alpha}R_\alpha$, where R_α is the curvature scalar formed from $g_{\mu\nu\alpha}$ In general, then, the f-meson couplings are analogous to very strong gravitational couplings, with the f-meson mass terms breaking the gravitational gauge invariance. For the situation where one has only one f meson present our "metric space" is analogous to that of Zumino. However, the "metric space" considered here is considerably more complicated than such a Riemannian space as more than one metric, $g_{\mu\nu\alpha}$, $\alpha = 1,2, \ldots$, is defined on it, and hence by algebraic combinations an infinite number of "metrics" exist. (It is noted that in general these metrics will depend nonlinearly on the f-meson fields.) Broken scale invariance is introduced through a new postulate which requires that the improved Belinfante stress tensor and its trace play a fundamental role as sources of the $J^P = 2^+$, 0^+ mesons with a universal coupling strength. The universality also leads to new relations of the type $g_f = F_\sigma m_f^2$, etc., between the f- and σ-meson interpolating constants which resemble the Kawarabayashi–Suzuki–Riazuddin–Fayyazuddin-type relations in current algebra. The form of the vector current in the presence of broken scale invariance is derived. The condition of scale breaking implies that the vector current has canonical scale dimension 3, and the apparent conflict of conservation of vector current with the f couplings is resolved. Experimental tests of the present formalism are indicated here and will be examined in detail in a subsequent paper. (auth)

57372 ROLE OF CROSSING AND THE ρ MESON IN LOW ENERGY ππ AMPLITUDES. Basdevant, J. L.; Froggatt, C. D.; Petersen, J. L. (CERN, Geneva). Phys. Lett.; 41B: No. 2, 173-7(18 Sep 1972).

The crossing conditions on physical region ππ partial wave amplitudes are used to study the implications of the existence of the ρ. It is shown that the mere existence of the ρ does not constrain appreciably the s wave scattering lengths and that no correlation from crossing between the ρ and the $I = 0$ ϵ resonance can be established without further physical assumptions. (auth)

Strong (Baryon No. = 1)

Refer also to abstract 57452.

57373 (CERN–72-10, pp 259-74) PROBLEMS WITH DEUTERIUM. Castelli, E. (Univ., Trieste, Italy).

From Symposium on nucleon–antinucleon annihilations; Chexbres, Switzerland (27 Mar 1972).

The validity of the impulse approximation for the $\bar{p}d$ interaction is briefly reviewed. Recent counter data on the $\bar{p}d$ total cross section are analyzed and the criteria for studying particular final states are reported. Bubble chamber experiments are then discussed. The difficulties in extracting the free-neutron cross sections are considered in some detail taking as a reference a recent analysis of the K^+-nucleon system. (L.B.S.)

57374 (JINR-P1-6549) PARTIAL-WAVE ANALYSIS OF $\pi N \rightarrow \pi\pi N$ IN THE NEIGHBORHOOD OF THE THRESHOLD OF Δ_{1236} RESONANCE ALLOWING FOR THE CONTRIBUTION OF A TRIANGULAR GRAPH. PART II. RESULTS OF ANALYSIS. EVALUATION OF THE LENGTH OF ππ SCATTERING a_0. Bunyatov, S. A.; Kurbatov, V. S.; Likhoded, A. K.; Shtaudenmaier, G. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

The results of a partial-wave analysis of five channels are given for the reactions $\pi N \rightarrow \pi\pi N$ at an energy of 430 to 450 MeV on the basis of a model and allowing for the contribution of a triangular graph. The necessity of making such an allowance for a compatible description of all five channels of the above reactions is demonstrated. Three solutions were obtained which yield coincident values of the length ππ of scattering a_0 which may be used to obtain the sign and magnitude of $a_0 = (0.65 \pm 0.16)\ n/\mu_\pi C$. (tr-auth)

57375 (LBL–1040) REFORMULATION OF N/D METHOD AND ITS APPLICATION TO πN PHASE SHIFT ANALYSIS. Chen, Chih Kwan (California Univ., Berkeley. Lawrence Berkeley Lab.). 14 Aug 1972. Contract W-7405-eng-48. 66p. Dep. NTIS.

Thesis.

The N/D method is reformulated rigorously, and a specific class of models, in which the high- and intermediate-energy behavior of the input potential can be expressed by Regge parameters, is then investigated. A smoothing procedure of partial-wave phase shifts is discussed based on a circular application of the formulated N/D method. In this smoothing procedure CDD pole parameters are handled unambiguously, and the output solution is guaranteed to be free from causality violating singularities. The application of this smoothing procedure to πN partial-wave phase shift analysis is discussed, and an example of smoothing of a πN P_{33}-wave is given. (auth)

57376 (RLO–1388-639) UNIVERSAL CURVE FOR MESON–NUCLEON ELASTIC SCATTERING. Blaha, S.; Pardee, W. J.; Sukhatme, U. P. (Washington Univ., Seattle. Dept. of Physics). 1972. 10p. Dep. NTIS.

All available high energy meson-nucleon differential elastic cross section data are plotted against a simple kinematic variable, and it is shown that the forward and backward region data fall on a universal curve. Some consequences are discussed. (auth)

57377 DYNAMIC MODEL FOR 33-PHASE SHIFT OF πN SCATTERING. Vall, A. N.; Kafiev, Yu. N.; Serebryakov, V. V. (Inst. of Mathematics, Moscow). Yadern. Fiz.; 16: No. 1, 198-202(Jul 1972). (In Russian).

Proceeding from the fact that low-energy contributions of u-channel cut to backward πN-scattering are negligible as compared with the direct integral, a model for 33-phase shift was constructed. The ρ-wave characteristics are described in terms of coupling constants and masses of the bosons exchanged in the annihilation channel. The values of the constants are discussed, and predictions of the model are compared with the experimental data. (auth)

57378 EMPIRICAL MASS FORMULA FOR BARYONS AND MESONS. Agarwal, B. K. (Allahabad Univ., India). Indian J. Phys.; 45: No. 9, 406-10(Sep 1971).

Known masses for baryons and mesons are found to be closely given by the formula $M = 139a + 96b$ where a and b are integers. The justification for restrictions on the values of a and b is drawn from an analogy with Thomson's plum-pudding model of the atom. (auth)

57379 RESONANCES AND THE PROPERTY OF SCALING. Pavkovic, M. I. (New York Univ., N. Y.). Lett. Nuovo Cim.; 5: No. 4, 319-26(23 Sep 1972).

The scaling of form factors and a new natural definition of averaging over the resonances are discussed. The resonance averaging definition is extended into the annihilation channel $e^- + e^+ \rightarrow p + N^*$. (J.F.P.)

57380 SCATTERING THEORY IN A MODEL OF QUANTUM FIELDS. II. Albeverio, Sergio (Princeton Univ., N. J.). Helv. Phys. Acta; 45: No. 1, 303-21(1972).

The study of the scattering theory is pursued in Nelson's model with relativistic kinematics ("Eckmann's model"). For the choice of mass renormalization yielding a renormalized Hamiltonian with the relativistic single-particle spectrum, physical asymptotic nucleon fields are constructed as strong limits of dressed fields on dense sets of states with finitely many nucleons and arbitrarily many mesons. The commutation relations of the asymptotic fields among themselves, with the asymptotic meson fields and with the Hamiltonian are derived, as well as the asymptotic decomposition of the latter and the relation with the wave operators. An expression for the S-matrix is also given, which is then discussed for the case of the meson-nucleon scattering. (auth)

57381 MODEL INDEPENDENT CALCULATION OF Kp DISPERSION RELATIONS. Lopez, C. (Univ. Autonoma, Madrid); Yndurain, F. J. Phys. Lett.; 41B: No. 2, 183-8(18 Sep 1972).

Using an extrapolation procedure previously proposed, which is based on rigorous properties of Padé approximants, forward Kp dispersion relations are computed. Among other results, averages of the absorptive part of the amplitude in the unphysical cut, and the absolute bounds $12.39 \leq \overline{G}^2/4\pi \leq 16.45$, and statistical estimate and errors $\overline{G}^2/4\pi = 14.15 \pm 1.17$, for the combination $\overline{G}^2 = G^2_{p\Lambda K} + 0.92\ G^2_{p\Sigma K}$ are obtained. This is to be compared with the result of the polynominal extrapolation of Cutkosky and Deo, $\overline{G}^2/4\pi = 15^{+6}_{-4}$, the lower bound of Rogers, $\overline{G}^2/4\pi \geq 10$, and a host of model-dependent calculations for which $\overline{G}^2/4\pi$ ranges between 4 and 20. (auth)

57382 DUALITY AND THE ROLE OF DAUGHTERS IN $\overline{K}N \rightarrow \pi\Lambda$. Kernan, A. (Univ. of California, Riverside); Poe, R. T.; Shen, B. C.; (and others). Contract AT(04-3)-34P107B. Phys. Lett.; 41B: No. 2, 163-6(18 Sep 1972).

In the reaction $\overline{K}N \rightarrow \pi\Lambda$ at $E_{cm} = 1.54$ to 2.15 GeV semi-local averaging to zero of the t-channel helicity amplitudes at $t \approx t_{min}$ is observed, as predicted by quark graph duality. The dominant mechanism for averaging is cancellation between $\Sigma_\gamma(3/2^-)$ and $\Sigma_\alpha(5/2^+)$, and between $\Sigma_\beta(5/2^-)$ and $\Sigma_\delta(7/2^+)$. Daughter resonances appear to cancel semi-locally among themselves following the same pattern. The overall cancellation pattern is between consecutive towers of resonances. (auth)

57383 σ TERM IN PION–NUCLEON SCATTERING. Schnitzer, Howard J. (Brandeis Univ., Waltham, Mass.). Phys. Rev., D; 6: No. 6, 1801-2(15 Sep 1972).

When an error in earlier work is corrected, it is shown that the requirements of t-channel unitarity do not affect the validity of the extrapolation procedure of Cheng and Dashen. This conclusion also holds in an extension of our earlier analysis to the case where the σ field transforms as a member of the (N/2,N/2) representation of chiral $SU(2) \times SU(2)$. (auth)

57384 SECONDARY TRAJECTORIES AND THE $\overline{K}N$–KN CHARGE-EXCHANGE CROSS-SECTION DIFFERENCE. McElhaney, R. M. (Univ. of Hawaii, Honolulu). Nuovo Cim.; 11A: No. 2, 436-46(21 Sep 1972).

A Regge analysis of the cross-section difference for the two line-reversed reactions $K^-p \rightarrow \overline{K}^0n$ and $K^+n \rightarrow K^0p$ in terms of the ρ, ρ', A_2 and A_2' Regge poles is presented. As a constraint the πN charge-exchange process is simultaneously fit with SU_3-related couplings. It is found that this scheme does not provide a consistent description of these processes. (auth)

57385 DUAL-RESONANCE MODEL FOR THE $K^+K^-p\bar{n}\pi^-$ SYSTEM WITH APPLICATION TO THE REACTIONS $K^+p \rightarrow K^+\pi^+n$, $K^+n \rightarrow K^+\pi^-p$ AND $K^-n \rightarrow K^-\pi^-p$. Lyberg, M. D. (Univ. of Lund, Sweden). Nuovo Cim.; 11A: No. 2, 487-98(21 Sep 1972).

A dual-resonance model for the $K^+K^-p\bar{n}\pi^-$ system which has earlier been applied to the reaction $K^-p \rightarrow K^-\pi^+n$ is applied to the reactions $K^+p \rightarrow K^+\pi^+n$, $K^+n \rightarrow K^+\pi^-p$ and $K^-n \rightarrow K^-\pi^-p$. Mass distributions, momentum transfer distributions, Jackson and Treiman–Yang angle distributions and total cross sections are compared to experimental data. The overall agreement is decent. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 57246, 57549, 57550, 57551, and 57999.

57386 (DNPL/P–134) COMMENT ON THE ISR DIFFRACTION SLOPE AND THE PROTON DIPOLE FORM FACTOR. White, J. N. J. (Daresbury Nuclear Physics Lab. (England)). Aug 1972. 10p. Dep. NTIS (U. S. Sales Only).

Analysis of the latest ISR pp diffraction data using the Chou-Yang model with dipole form factor, $F(q^2) = (1 + q^2/\mu^2)^{-2}$, gives values of μ^2 which decrease slowly with energy and which are close to $\mu^2 = 0.71\ (\mathrm{GeV}/c)^2$, the value obtained from fits to electromagnetic form factors. (auth)

57387 INFLUENCE OF MAJORANA FORCES ON THE PROPERTIES OF HYPERNUCLEI OF p-SHELL. Kochetov, A. B.; Khrylin, B. A. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 16: No. 1, 50-2(Jul 1972). (In Russian).

The influence of the Majorana forces on the properties of hypernuclei of p-shell is analyzed. It is shown that account for deformations and application of different NN-potentials do not greatly influence the separation energy of Λ-particle. A quantitative estimation of suppression of ΛN-interaction in p-state was carried out. (auth)

57388 MONTE CARLO CALCULTIONS OF HIGH-ENERGY NUCLEON–MESON CASCADES AND COMPARISON WITH EXPERIMENT. Armstrong, T. W.; Alsmiller, R. G. Jr.; Chandler, K. C.; Bishop, B. L. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng.; 49: No. 1, 82-92(Sep 1972).

A Monte Carlo transport code for calculating high-energy nucleon-meson cascades in thick targets is described. The calculational method uses an intranuclear-cascade-extrapolation-evaporation model for treating nonelastic collisions $\gtrsim 3$ GeV. Calculated results for the development of the cascade induced in thick iron targets by 10-, 19.2-, 29.4-, and 200-GeV/c protons are presented. For the cases of 10-, 19.2-, and 29.4-GeV/c incident protons, comparisons are made with experimental data and, in general, good agreement is obtained. (auth)

57389 NON-CLASSICAL EFFECTS IN MULTIPARTICLE PROPAGATION THROUGH A NUCLEUS AND THE $\pi \rightarrow A_1$ PROBLEM. Fishbane, P. M.; Newmeyer, J. L.; Trefil, J. S. (Univ. of Virginia, Charlottesville). Phys. Lett.; 41B: No. 2, 153-6(18 Sep 1972).

The effective cross-section for the propagation of n independent particles through a nucleus can be appreciably less than the sum of their individual cross-sections. Applied to the A_1 problem it is concluded that the A_1 is not an unbound $\rho\pi$ (Deck mechanism) or 3π system. (auth)

57390 PROTON SPECTRA ACCORDING TO THE DIFFRACTION EXCITATION MODEL. Gottfried, K.; Kofoed-Hansen, O. (CERN, Geneva). Phys. Lett.; 41B: No. 2, 195-200(18 Sep 1972).

Inclusive proton spectra arising from pp collisions are calculated from the diffraction excitation model. Comparison with the data shows that diffraction dissociation cannot account for a major part of σ_{inel} at low energies ($s \lesssim 50\ \mathrm{GeV}^2$), but that it could be the dominant mechanism at ISR energies. (auth)

57391 PROTON–PROTON INCLUSIVE SPECTRA IN THE THERMODYNAMICAL MODEL. Letessier, J.; Tounsi, A. (Institut de Physique Nucleaire, Paris). Nuovo Cim.; 11A: No. 2, 353-66(21 Sep 1972).

The formulas of the momentum spectra given by the thermodynamical model are modified when the "locality" of conservation laws is given different senses. The resulting modifications to the formulas of Hagedorn and Ranft are given. In contrast to the calculations of these authors it is shown that one velocity function $F(\lambda)$ is enough to describe the kinematical part of the p-p inclusive reactions; their second velocity function $F_0(\lambda)$ is not needed, and thus three free parameters are eliminated. Furthermore, the number of the remaining parameters is reduced by other arguments and very good fits of the present experimental data are obtained. (auth)

57392 PRIMARY-ENERGY ESTIMATION IN HIGH-ENERGY INTERACTIONS WITH A NUCLEUS. Bhowmik, B.; Singh, S.; Kaul, S. K. (Univ. of Delhi). Nuovo Cim.; 11A: No. 2, 333-43(21 Sep 1972).

A new method for the estimation of the primary energy in high-energy collisions with a nucleus is suggested. The collision mechanism (tube or cascade) responsible for an individual interaction is ascertained by applying a suitable kinematical criterion. The primary energy is then estimated taking due account of the secondary processes, such as the subsequent collisions of the primary and the absorption and recreation of created pions inside the nucleus. The method was verified by using the data on the interactions of 22.8 GeV/c protons and 50 GeV/c pions with the complex nuclei of nuclear emulsion. The percentage of coherent production is found to increase with energy and at these two energies its values are 27 and 53 respectively. (auth)

57393 INTERPRETATION OF THE MULTIPLICITY DISTRIBUTION AT 200 GeV/c. Berger, Edmond L. (Argonne National Lab., Ill.). Phys. Rev. Lett.; 29: No. 13, 887-90(25 Sep 1972).

Data on charged-particle multiplicities in 200-GeV/c pp interactions are compared with data at lower energies and with predictions of current models. Fragmentation models are shown to be in substantial agreement with present results, but a multiperipheral view cannot be excluded. Further tests are suggested. (auth)

Particle Invariance Principles and Symmetries

57394 GAUGE THEORY OF STRONG, WEAK, AND ELECTROMAGNETIC INTERACTIONS. Bars, I.; Halpern, M. B.; Yoshimura, M. (Univ. of California, Berkeley). Phys. Rev. Lett.; 29: No. 14, 969-72(2 Oct 1972).

With the recent $U(3) \otimes U(3)$ gauge model of strong interactions as a basis, the very natural synthesis with Weinberg's model of leptons is discussed. As a result of the interplay of the two models neutral $\Delta S = 1$ currents are eliminated without enlarging the number of quarks, and a natural $(3,\bar{3}) \oplus (3,\bar{3})$ symmetry breaking emerges for the hadrons. Incorporation of alternative lepton theories is mentioned. (auth)

General

Refer also to abstracts 57409, 57416, 57449, 57992, and 57998.

57395 n-BODY PROBLEM. MATRIX ELEMENTS OF PERMUTATION GROUP. Kil'dyushov, M. S. (Moscow Physical-Technical Inst.). Yadern. Fiz.; 16: No. 1, 217-21(Jul 1972). (In Russian).

Matrix elements of the permutation group in the "trees" basis were calculated for a system of n identical particles. (auth)

57396 DISTRIBUTIONS ON MINKOWSKI SPACE AND THEIR CONNECTION WITH ANALYTIC REPRESENTATIONS OF THE CONFORMAL GROUP. Ruehl, W. (Univ. Trier, Kaiserslautern, Ger.). Commun. Math. Phys.; 27: No. 1, 53-86(1972).

Unitary analytic representations of the conformal group are realized on Hilbert spaces of holomorphic or antiholomorphic functions over a tube domain in complex Minkowski space. The distributional boundary values of these functions are tempered distributions on real Minkowski space. The representations are characterized by an integral scale dimension label n and two spin labels j_1 and j_2. The connection between the dimension n and the degree of singularity of the tempered distribution is investigated. An application to inclusive reactions of elementary particles is proposed. (auth)

57397 GROUP ALGEBRAS AND TENSOR OPERATORS. Killingbeck, J. (Univ. of Hull, Eng.). J. Phys., A (London); 5: No. 8, 1131-7(Aug 1972).

The conditions under which class sum operators for a finite group are hermitian are discussed. A class of linear mappings within the group algebra is treated, together with methods of obtaining elements which are symmetry adapted with respect to these mappings. Traditional tensor operators are treated as symmetry adapted elements of the group algebra, and the absence of certain types of tensor operator from the group algebra of direct product groups is discussed. The relevance of the work to operator equivalent theory is briefly indicated. (auth)

57398 UNITARY REPRESENTATIONS OF THE LORENTZ GROUP. Smorodinskii, Ya. A.; Khusar, M. (Joint Inst. of Nuclear Research, Dubna, USSR). Fiz. Elem. Chastits At. Yadra; 3: No. 1, 223-37(1972). (In Russian).

Matrix elements and spherical functions of unitary representations of the Lorentz group are derived in the unitary spinor basis. Representations in the angular momentum basis are also considered, and it is shown that the boost function can be expressed in terms of complex Wigner coefficients of the rotation group. (auth)

57399 OPERATOR TOWER OF CANONICAL DIMENSIONS. Gatto, R. (Univ., Rome); Sartori, G. Phys. Rev., D; 6: No. 6, 1809-11(15 Sep 1972).

It is shown that smoothly broken scale invariance implies, under general assumptions, existence and canonical dimensions for an infinite sequence of symmetric traceless local tensor operators. (auth)

Applications (Electromagnetic and Weak)

57400 (IC-72/85) DEFORMED CURRENT ALGEBRA AND COMPUTATION OF THE CABIBBO ANGLE. Oehme, Reinhard (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1972. 22p. Dep. NTIS (U. S. Sales Only).

The empirical suppression factor for strangeness-changing weak amplitudes (Cabibbo angle, θ) is related to symmetry-breaking effects in the hadronic weak current. The correction of the octet currents introduces one coefficient, ξ, which is a function of the parameter c appearing in the quark mass matrix $M = \lambda_0 + c\lambda_8$, and which is identified with tg θ. The modified current components satisfy a deformed SU(3) × SU(3) algebra, but the subalgebra of chiral SU(2) × SU(2) remains unchanged. The assumption is made that the weak interactions conserve strangeness in the soft pion limit $c = -\sqrt{2}$. With this boundary condition, and the requirement of hermitian current components, the expression tg $\theta = 1 - \frac{1}{2} c^2$ is obtained in lowest, nontrivial order of symmetry breaking. Since the parameter c can be related to meson splittings, one finds tg $\theta \approx 0.22$ with $c = -1.25$. The problem of antihermitian current corrections is discussed briefly. (auth)

57401 P-ODD NUCLEAR FORCES AND CP-VIOLATION IN THE RENORMALIZABLE WEAK INTERACTION THEORY. Shabalin, E. P. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 15: No. 4, 820-6(Apr 1972). (In Russian).

In the frame of the renormalizable weak and strong interaction theory the renormalization procedure is shown to lead to a P-odd nuclear force value being consistent with the experiment even in that case when P-invariance violation of the hadronic part of the weak interaction takes the maximum value. A simple mechanism of the CP-violation in the renormalizable theory of the weak interaction is considered. (auth)

57402 U(4)-SYMMETRY OF LEPTONS AND QUARKS. Akulov, V. P.; Volkov, D. V. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 15: No. 4, 827-32(Apr 1972). (In Russian).

An U(4)-symmetry unitary scheme for leptons and quarks was proposed. A structure of charged and neutral currents was considered. The existence of a heavy neutral lepton is predicted. (auth)

57403 EFFECTIVE SU(2) x SU(2) SYMMETRY VIOLATIONS GENERATED BY ELECTROMAGNETIC AND WEAK INTERACTIONS. Olshansky, R. (Laboratoire de Physique Theorique et Hautes Energies, Paris); Phan Xuan Yem. Phys. Lett.; 41B: No. 2, 192-4(18 Sep 1972).

The interplay among the SU(3) × SU(3) violating interaction and the electromagnetic and weak interactions is considered in the context of the (3,3*) + (3*,3) symmetry breaking model. It is argued that the symmetry breaking Hamiltonian determined phenomenologically represents the effective interaction which generates the tadpole contributions coming from all symmetry violating interactions. (auth)

Applications (Strong)

Refer also to abstract 57353.

57404 BARYONS AND PSEUDOSCALAR MESONS IN BROKEN NONLINEAR CHIRAL SU(3) x SU(3)-DYNAMICS. Gaisak, M. I.; Sabo, V. Ya. (Uzhgorod State Univ., USSR). Yadern. Fiz.; 16: No. 1, 203-8(Jul 1972). (In Russian).

A Lagrangian, invariant with respect to nonlinear chiral transformation of SU(3) × SU(3) group, is violated by the term, which is a combination of zero- and eighth components of (3,3*) ⊕ (3*,3)-representation. On the basis of the violated Lagrangian s- and p-wave lengths of PP- and PB-scatterings were calculated. They are in a good accordance with available experimental data. These results are compared with the results obtained in the framework of another approaches. (auth)

57405 INVARIANT TENSORS IN SU(3). II. Dittner, P. (Imperial Coll. of Science and Tech., London). Commun. Math. Phys.; 27: No. 1, 44-52(1972).

Invariant SU(3) octet tensors are constructed in terms of λ matrices and applied to the problem of forming tensors from a single octet used repeatedly. Next a similar problem but with two octets is considered which demonstrates that different outer products of invariant tensors may be related. Finally, a theorem is proved which shows that the number of invariant tensors is essentially finite, and that relations of ranks greater than six exist on outer products of these tensors. (auth)

57406 O(3,1)-MODEL WITH MESONS HAVING AN INNER STRUCTURE. Belinicher, V. I. (Inst. of Mathematics, Moscow). Yadern. Fiz.; 15: No. 4, 833-45(Apr 1972). (In Russian).

A quark group model was considered. To describe baryons infinite-component fields are introduced which are transformed according to unitary Lorentz group representations. Two models were considered: mesons are described with usual fields; mesons are described with infinite component fields. Lorentz invariant Lagrangians were constructed in the both models. Partial particle decay widths were compared with experimental data and results of previous work. Analytical properties of the vertex functions and a connection with the Regge pole theory were discussed. (auth)

57407 HADRON STATES IN THE LADDER U(6,6)-SYMMETRY SCHEME. Drenska, S. B.; Ivanov, M. I.; Nikolov, A. V.; Vaklev, Y. S. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 5, 593-6(1972).

A method is given which permits one to obtain all the hadron states envisioned in the ladder U(6,6) symmetry scheme. The results for baryons and mesons are tabulated. (J.F.P.)

57408 BOOTSTRAP CONDITIONS AND QUARK DIAGRAMS. Van Parijs, J.; Speiser, D.; Weyers, J. (Univ. of Louvain, Belgium). Nuovo Cim.; 11A: No. 2, 295-304(21 Sep 1972).

It is shown that duality and the absence of exotic resonances are dynamical principles which are compatible with symmetries other than SU_n. Quark diagrams merely reflect the crossing symmetry properties of a "composite object." (auth)

Field Theories

General

57409 TYPE OF QUASI-FREE REPRESENTATIONS OF THE CLIFFORD ALGEBRA. Testard, D. (Centre National de la Recherche Scientifique, Marseille). Ann. Inst. Henri Poincare, Sect. A; 12: 329-41(1970). (In French).

It is shown that the type of the representation induced by a quasi-free state may be studied in certain cases, as an application of K.M.S. boundary condition for the unique evolution which agrees this state. Some results concerning the type of powers product of states were obtained. (France)

57410 EXTERNAL FIELD OF A LOCALIZED CHARGE IN UNIFIED FIELD THEORY. Pant, D. N. (Banaras Hindu Univ., India). Gen. Relativity Gravitation; 3: No. 1, 29-33(Jun 1972).

The possibility of the existence of a localized charge distribution giving rise to a special axially symmetric electrostatic field was explored in Einstein's unified field theory. The field equations have been studied in two particular cases. In one case the field equations have a solution representing flat space—time along with an electrostatic field which is constant in the direction of the axis of symmetry. For the other case the solution is nonexistent. (auth)

57411 MAXWELLIAN PARTICLES WITH REAL MASS AND ISOTROPIC SPACE–TIME VELOCITY. Boudet, Roger (Univ., Marseille). Compt. Rend., Ser. A; 274: No. 26, 1970-1(26 Jun 1972). (In French).

All the Maxwell equations are deduced from the Hestenes equation. (France)

57412 ELECTRODYNAMICS IN AN EXPANDING UNIVERSE. Tauber, G. E. (Tel Aviv Univ., Israel). Gen. Relativity Gravitation; 3: No. 1, 17-27(Jun 1972).

An algebraic form of the energy momentum tensor of the electromagnetic field is derived in terms of two scalars and two mutually orthogonal vector fields. Upon inserting this tensor into the field equations, solutions of the co-determined Einstein-Maxwell equations are obtained. The line element used is that corresponding to a conformal flat universe, whose form is then uniquely determined by the field equations. The case of a charged fluid is also considered, and it is found that the particular form of the velocity field chosen limits the choice of the possible equation of state connecting the pressure and density distributions. (auth)

Quantum Field Theory

Refer also to abstracts 57297, 57305, 57306, 57314, 57343, 57380, 57475, 57484, and 57527.

57413 (COO–3067(2)-9) LIGHT CONE BEHAVIOR OF PERTURBATION THEORY. Christ, N.; Mueller, A. (Columbia Univ., New York); Hasslacher, B. (Illinois Univ., Urbana). 1972. 62p. Dep. NTIS.

A technique introduced by Symanzik is used to derive a series of equations obeyed order by order in perturbation theory by the structure functions W_1 and νW_2 entering the cross section for inelastic electron scattering. These equations relate the q^2, ν and coupling constant dependence of W_1 and νW_2 in a manner reminiscent of the renormalization group results of Gell-Mann and Low. The equations are used to compute the leading logarithmic contribution to νW_2 in a theory of fermions coupled to pseudoscalar particles and a theory of fermions coupled to vector particles. (auth)

57414 (DEMO–72/8) STUDY OF THE MASSIVE SUPERPROPAGATOR. Georgalas, C. G. (Democritus Nuclear Research Center, Athens (Greece)). Jun 1972. 19p. Dep. NTIS (U. S. Sales Only).

The massive superpropagator is studied in momentum space. Some previously unnoticed features of this quantity are pointed out and a relatively simple explicit expression is given, simulating the behavior of the exact superpropagator better then the zero-mass approximation. (auth)

57415 (ITF–72-64-E) RENORMALIZED POWER OF THE GENERALIZED RANDOM FIELD AND THE EQUATIONS FOR GREEN'S FUNCTIONS IN THE EUCLIDEAN DOMAIN. Gonchar, N. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 19p. Dep. NTIS (U. S. Sales Only).

The concept of the renormalized power of the generalized Gaussian random field is investigated. This concept is applied to remove ultraviolet cutoff in the solution obtained earlier for the "cutoff" equations of Green's functions in the euclidean domain for some class of nonlinear self-interactions. The problem of removing a space–time cutoff for the polynomial types of self-interactions is discussed. (auth)

57416 (SU–4205-259) BREAKING CHIRAL AND SCALE SYMMETRY OF A LAGRANGIAN WITH MASSIVE GAUGE FIELDS. Hudnall, W. (Syracuse Univ., N. Y. Dept. of Physics). Apr 1972. 17p. (NYO–3399-259). Dep. NTIS.

The effects of adding the $1^{\pm}$ gauge fields to an SU(3) sigma model of the $0^{\pm}$ fields are investigated. Particular attention is given to the requirements of broken scale invariance on the simple model where the "(3,3*)" chiral and scale symmetry-breaking terms coincide. Also the mass spectrum and the scalar meson trilinear decay widths are calculated. (auth)

57417 CHRONOLOGICAL PRODUCTS AND EQUAL-TIME COMMUTATORS IN PERTURBATION THEORY. Veinshtein, A. I.; Sokolov, V. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz.; 16: No. 1, 209-16(Jul 1972). (In Russian).

The Bjorken, Johnson, and Low theorem that connects T-products and equal-time commutators is treated using simple examples in the framework of perturbation theory. In the cases, when matrix elements of the T-product and of the equal-time commutator are finite, this theorem is always valid. However, equal-time commutators do not coincide, generally speaking, with "naive" ones and depend on the kind of interaction. It is shown, that equal-time commutation relations of field operators remain canonical. The other equal-time commutators may in principle be calculated with the help of canonical commutation relations, taking into account a singular character of the field operators product at the coinciding points. It is shown, that application of Feynman rules to calculations of T-products leads to wrong result in some cases. It is connected with inapplicability of the Wick theorem for formally diverging diagrams. (auth)

57418 INTEGRATION CONDITIONS FOR THE EQUATIONS OF HIGH SPIN FIELDS IN A CURVED SPACE–TIME. Castagnino, Mario. Compt. Rend., Ser. A; 274: No. 14, 1135-7(5 Apr 1972). (In French).

Under the assumption of a nonzero cosmological constant, the free field theory must be formulated in spaces with constant curvature (e.g., De Sitter space). The theories arising from the SO(1,4) group for high spins are the tensor theory and the Rarita–Schwinger theory. The integration conditions for these theories are studied. (auth)

57419 NELSON'S SYMMETRY AND THE INFINITE VOLUME BEHAVIOR OF THE VACUUM IN $P(\phi)_2$. Guerra, F.; Rosen, L.; Simon, B. (Joseph Henry Labs., Princeton, N. J.). Commun. Math. Phys.; 27: No. 1, 10-22(1972).

Let H_l be the Hamiltonian in a $P(\phi)_2$ theory with sharp space cutoff in the interval $(-l/2,l/2)$. Let $E_l = \inf\sigma(H_l)$, $\alpha(l) = -E_l/l$, and let Ω_l be the vacuum for H_l. Properties of $\alpha(l)$ and Ω_l are discussed. In particular, as $l \to \infty$, there are finite constants $\beta_\infty < 0$ and α_∞ such that $\alpha(l)\uparrow\alpha_\infty$, $(\alpha(l) - \alpha_\infty)l\downarrow\beta_\infty$, and hence $\alpha(l) = \alpha_\infty + \beta_\infty/l + o(l^{-1})$. Moreover $\exp(-c_1 l) \leqq ||\Omega_l||_1 \leqq \exp(-c_2 l)$ for c_1, c_2 positive constants, where $||\Omega_l||_1$ is the $L^1(Q,d\mu_0)$ norm of Ω_l with respect to the Fock vacuum measure. Also a new proof of recent estimates of Glimm and Jaffe on local perturbations of H_l in the infinite volume limit is presented. (auth)

57420 QUANTUM THEORY OF PARAMETRICALLY INTERACTING ELECTROMAGNETIC OSCILLATIONS. I. Boitsov, V. F.; Slyusarev, S. G. Vestn. Leningrad. Univ., No. 22, Fiz., Khim.; No. 4, 35-42(Nov 1971). (In Russian).

The dynamics of three quantum electromagnetic modes parametrically coupled with each other by means of two classical pumping fields with basic and double frequencies was considered. The expressions for Heisenberg operators of creation and annihilation were obtained, which characterize the amplified fields. If the initial field modes are not excited, the average number of photons in each of them will along with their exponential increase undergo the pulsations with the frequency which may be in the radiofrequency region. In the absence of the second harmonics of pumping field these pulsations will disappear. (auth)

57421 SOME ANALYTICITY PROPERTIES IMPLIED BY THE TWO-PARTICLE STRUCTURE OF GREEN'S FUNCTIONS IN GENERAL QUANTUM FIELD THEORY. Bros, Jacques (Inst. for Advanced Study, Princeton, N. J.). pp 85-133 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

Under the usual general assumptions of quantum field theory (locality and spectrum), an analytic solution of the Bethe–Salpeter equation can be defined, after a suitable regularization. This solution satisfies the complete primitive analytic structure of a general fourpoint function, and under some additional technical assumptions, it can be proved to be two-particle irreducible. Among the analyticity properties of the scattering amplitude which are implied by this structure, the existence of a two-sheeted Riemann surface is derived over a domain which includes the "elastic part" of the physical region. (auth)

57422 COHERENT STATE REPRESENTATION AND QUANTUM FIELD THEORY. Rohrlich, F. (Syracuse Univ., N. Y.). pp 279-302 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

The coherent state representation is briefly reviewed for one, several, and an infinite number of degrees of freedom. The relation of this representation to Hilbert spaces of analytic functions and to continuous representation theory is pointed out. It is demonstrated how this representation leads in a natural way to the definition of the operator derivative of a functional of a quantized Bose field. The fermion field theory, the limited applicability of the coherent state representation, and the mathematical difficulties of the functional formulation are discussed; it is shown how these difficulties are overcome by the operator derivative calculus for fermion fields. A summary is given which indicates the use of this calculus for the formulation of quantum field theory. (L.B.S.)

57423 COMPLEX PROJECTIVE SPACE AND ANALYTIC WIGHTMAN FUNCTIONS. Manoharan, A. C. (Univ. of Wisconsin, Milwaukee). pp 487-95 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

A problem that arises in the study of relativistic quantum field theory which can be fitted in the complex projective space P^{2n-2} is examined. The n-point Wightman function W^n corresponding to the vacuum expectation value of the product of n scalar field operators in two-dimensional spacetime is considered. (L.B.S.)

57424 HAAG THEOREM AND LIE-ADMISSIBLE ALGEBRAS. Santilli, Ruggero M. (Univ. of Miami, Coral Gables, Fla.). pp 521-9 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

A system of interacting fields is considered according to the following scheme: (I) asymptotic region, $t \to -\infty$, (II) interacting region, and (III) asymptotic region, $t \to +\infty$. The free asymptotic regions I and III possess a Lie algebra invariance and can be characterized by the Lagrange—Hamilton formulation. An investigation is made of enlarged algebraic and analytic dynamics procedures as a possible approach to the interpolating region II. (L.B.S.)

57425 JOST—HEPP THEOREM FOR ANALYTIC VECTORS. Williams, David N. (Univ. of Michigan, Ann Arbor). pp 557-60 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

The Jost—Hepp theorem says that matrix elements of the four-dimensional translation operator between suitable vectors in the Hilbert space of a Wightman field theory (with a mass gap in the spectral condition) rapidly approach the matrix elements of the vacuum projection operator, for large, spacelike translations. It is remarked that matrix elements of the translation operator between analytic vectors of a unitary, continuous representation of the identity component of the covering group of the Poincaré group, iSL(2,C), approach their limit exponentially for spacelike directions and that the corresponding p-space measures are analytic in the three-momentum variables, under analogous spectral conditions. (auth)

57426 SOFT QUANTA. Itzykson, C. (CEN de Saclay, Gif-sur-Yvette, France). Ann. Phys. (Paris); 7: No. 1, 59-83 (Jan 1972).

The classical and quantum electrodynamics theory is briefly reviewed. Various aspects of the classical approximation are examined. The origin of the self-interaction term in the equation of motion (Dirac theory) is emphasized. A physical discussion of the low-energy effects, specially infrared divergence, leads to the study of the Green function singularities. The classical (eikonal) approximation in nonrelativistic and relativistic scattering theory is discussed (scattering amplitude for long-range forces). (France)

57427 CAUSALITY PROBLEMS IN GEL'FAND—YAGLOM EQUATIONS. Amar, V.; Dozzio, U. (Univ., Parma, Italy). Lett. Nuovo Cim.; 5: No. 4, 355-8(23 Sep 1972).

The following sufficient condition is proven in order to assure causal propagation for Gel'fand—Yaglom equations with the usual minimal electromagnetic coupling. A sufficient condition in order that a G—Y electromagnetic equation with unique mass have causal propagation is that Γ^0 be diagonalizable. (J.F.P.)

57428 RELATIONSHIP BETWEEN THE FIELD EQUATION AND THE HAMILTONIAN APPROACH. de Mottoni, P.; Tesei, A. (CNR, Rome). Lett. Nuovo Cim.; 5: No. 4, 341-5(23 Sep 1972).

Some comments on the relation between the Hamiltonian approach and the field equation one are made in order to point out some open problems which seem very general and deep. It is concluded that the field equation approach is more rich than the Hamiltonian one. (J.F.P.)

57429 UNIQUENESS OF THE VACUUM VECTOR IN AXIOMATIC QUANTUM FIELD THEORY. Todorov, T. S. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 4, 453-4(1972).

Neutral scalar field theory formulated by Wightman and field algebra are used to prove the uniqueness of the vacuum vector in the general frames of the adopted axioms. (J.F.P.)

57430 RELATIVISITIC HARMONIC OSCILLATOR. Harvey, A. L. (Queens Coll., Flushing, New York). Phys. Rev., D; 6: No. 6, 1474-6(15 Sep 1972).

A relativistic formulation of the simple harmonic oscillator is discussed. It differs from the customary formulation in that it is derivable from a Lorentz-invariant variational principle. A consistent relativistic quantization procedure is thereby admitted. (auth)

57431 SIGN OF THE STATIC ELECTRIC POLARIZABILITY IN RELATIVISTIC QUANTUM THEORY. Sucher, Joseph (Univ., Paris). Phys. Rev., D; 6: No. 6, 1798-1800(15 Sep 1972).

The question of the sign of the static electric polarizability α_E of an elementary system is studied within the framework of relativistic quantum theory. It is emphasized that a high-energy assumption is necessary to derive $\alpha_E > 0$. Thus, although available experimental information is consistent with this inequality, the discovery of a system for which α_E is negative does not appear to be excluded on the basis of general principles alone. (auth)

57432 ASYMPTOTIC BEHAVIOR OF THE ELECTROMAGNETIC FORM FACTOR IN QUANTUM ELECTRODYNAMICS: A FUNCTIONAL APPROACH. Gonzalez, M. A. (Univ. of Toronto). Phys. Rev., D; 6: No. 6, 1756-65(15 Sep 1972).

A simple derivation is given of the large-momentum-transfer behavior of the electromagnetic vertex in quantum electrodynamics by means of functional methods. Jackiw's result $\exp[-(e^2/16\pi^2)\ln^2(q^2/\mu^2)]$ is obtained by using an eikonal approximation for the electron propagator in an external field. (auth)

57433 TACHYONS AND CAUSALITY IN TWO DIMENSIONS. Murphy, J. E. (Louisiana State Univ., New Orleans). Phys. Rev., D; 6: No. 6, 1808-9(15 Sep 1972).

Using the Klein—Gordon equation and relativistic invariance we calculate the commutator and anticommutator for free tachyon fields in two dimensions. (auth)

57434 NONLINEAR LAGRANGIANS. Fukuda, R. (Tokyo Univ.). Phys. Rev., D; 6: No. 6, 1487-1500(15 Sep 1972).

Nonlinear Lagrangians are considered without using a polynomial expansion. The divergent expressions must be dealt with from the start; they reduce to a form similar to that in the polynomial case, and the analytic method due to Volkov and to Lee and Zumino is generalized to arbitrary order and to any Lagrangian, so as to define the meaning of this divergent quantity. Using this procedure, the unitarity relation in both x and p space is considered. Specific examples are given in second order, and high-energy behavior in p space and singular behavior in x space when $x^2 \to 0$ are considered. (auth)

57435 GLOBAL CHARGES AS INTEGRALS OVER DENSITIES. Maison, H. D. (CERN, Geneva). Nuovo Cim.; 11A: No. 2, 389-96(21 Sep 1972).

For a conserved local current $\partial^\mu j_\mu(x) = 0$ it is shown that the matrix elements $(\Psi, j_0(f_r)\Phi)$ between localized states Ψ and Φ of the smoothed integral $\int j_0(x) f_r(x) d^4x$ of the "charge" density $j_0(x)$ converge to the corresponding ones $(\Psi, Q\Phi)$ of the associated global "charge" Q whenever the latter exists, i.e., if the corresponding symmetry is not spontaneously broken. No assumptions about a gap in the energy-momentum spectrum are made. (auth)

57436 INFINITESIMAL INVARIANCE TRANSFORMATIONS. Dothan, Y. (CERN, Geneva). Nuovo Cim.; 11A: No. 2, 499-510(21 Sep 1972).

The infinitesimal invariance of a Lagrangian density up to a divergence is considered. The condition for such an infinitesimal invariance is formulated as a set of differential identities. An example demonstrates the type of calculations involved in applications of these conditions. (auth)

57437 ALGEBRAIC PROPERTIES OF THE DIRAC EQUATION. Ekle, G. G. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 84-9(1972). (In Russian).

A classification of operators of first order symmetry was derived for Dirac's equation according to their tensor properties of the transforms from a Lorenz homogeneous group. A minimum system was obtained for a ring of symmetry operators in connection with the free Dirac equation. The question of physical meaning of spin operators was examined; fields were found which allowed symmetry operators of the first order. (tr-auth)

Gravitation and General Relativity

Refer also to abstract 57993.

57438 MACH'S PRINCIPLE IN GENERAL RELATIVITY. Higbie, J. H. (Technion-Israel Inst. of Tech., Haifa). Gen. Relativity Gravitation; 3: No. 2, 101-9(Jun 1972).

Mach's principle is examined in the light of its recent formulation within general relativity. It is argued that properties of geometry which Mach did not envisage, specifically finite propagation velocity, and independent field excitations, destroy the philosophic justification of Mach's principle. What remains is a conjecture on which recent developments in cosmology throw doubt. A simpler and somewhat less Machian alternative proposed by Wheeler (Wheeler, J. (1964) Gravitation and Relativity (ed. Chiu, H. and Hoffman, W.) (Benjamin, New York). Chap. 15) is also discussed briefly. (auth)

57439 HORIZONS IN WEYL METRICS EXHIBITING EXTRA SYMMETRIES. Godfrey, B. B. (Princeton Univ., N. J.). Gen. Relativity Gravitation; 3: No. 1, 3-16(Jun 1972).

Static, axisymmetric, vacuum metrics are classified according to the homothetic motions they admit, with all having more than two homothetic motions explicitly computed. Within the two new families of spacetimes so determined, none of the metrics is asymptotically flat. Although most of the horizons are unlike that of the Schwarzschild metric, it is shown that they nonetheless all fall within a classification scheme previously developed for two-dimensional static metrics. The C-metric and the question of directional singularities are also briefly considered. (auth)

57440 CHARACTERISTIC FUNCTION OF ROBERTSON WALKER SPACES. Buchdahl, H. A. (Australian National Univ., Canberra). Gen. Relativity Gravitation; 3: No. 1, 35-41(Jun 1972).

The time-like geodesics of Robertson–Walker spaces have recently been considered by Noerdlinger (Noerdlinger, P. D., Phys. Rev., 186, 1969, p. 1347) from the Lagrangian point of view. Using the Hamiltonian point of view the characteristic function V of an arbitrary Robertson–Walker space is determined by integrating the differential equations which govern V. (auth)

57441 NOTE ON ASYMPTOTICALLY FLAT EMPTY SPACES. Unti, T. W. J. (Jet Propulsion Lab., Pasadena, Calif.). Gen. Relativity Gravitation; 3: No. 1, 43-58(Jun 1972).

The algebraic programming system FORMAC is used to extend asymptotic solutions of the Newman–Penrose equations. The expansions are then applied to metrics with geodesic rays and to the Newman–Penrose conserved terms. It is shown how the expansion may prove useful in finding new solutions to the field equations. (auth)

57442 SOLUTION OF THE EINSTEIN–MAXWELL EQUATIONS FOR A STATIC DISTRIBUTION OF MASSIVE CHARGED PARTICLES. Nordtvedt, K. (Montana State Univ., Bozeman). Gen. Relativity Gravitation; 3: No. 2, 95-100(Jun 1972).

Exact solutions of the general relativistic field equations of Einstein and Maxwell were found for a general static distribution of massive charged particles. As in the Newtonian case, the particles must have unit charge to mass ratio $e^2/m^2 = 1$. The active gravitational mass of the system of particles was precisely the sum of individual masses of the [illegible]tituent particles. (auth)

57443 FIRST DERIVATIVE DISCONTINUITIES OF THE SPACE-TIME METRIC TENSOR. Denisov, V. I. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 62: No. 6, 1990-7(Jun 1972). (In Russian).

First derivative discontinuities of the space-time metric tensor which is the solution of the Einstein gravitational equations are investigated. Expressions are obtained for discontinuities on non-isotropic and isotropic hypersurfaces. It is shown that for a non-isotropic discontinuity hypersurface the expression in the general case contains four scalars. It is proven that in this case there exists a coordinate system in which the first derivatives of the metric tensor are continuous. For an isotropic discontinuity hypersurface the expression for the discontinuity contains six scalars in the general case. First derivative discontinuities of a spherically symmetric space-time metric tensor are considered in various coordinate systems. (auth)

57444 EINSTEIN ALGEBRAS. Geroch, Robert (Enrico Fermi Inst., Chicago). Commun. Math. Phys.; 26: No. 4, 271-5 (1972).

An approach to quantization of general relativity using a reformulation of the classical theory in which the events of space-time play essentially no role is discussed. (auth)

57445 EXACT KERR–SCHILD TYPE VACUUM SOLUTIONS TO SALAM'S TWO-TENSOR THEORY OF GRAVITY. Mansouri, R.; Urbantke, H. K. (Univ., Vienna). Commun. Math. Phys.; 26: No. 4, 301-6(1972).

A Kerr–Schild type ansatz for the f and g tensor fields leads to a tractable form of the field equations of Salam's two-tensor theory of gravity in vacuo. While the general solution contains the Schwarzschild and Kerr metrics in the pure Einstein vacuum case, it is shown in the f–g case that all "nontrivial" ($f \neq g$) solutions are restricted to have the form of "plane-fronted waves". (auth)

57446 HYDROGEN ATOM IN THE FRIEDMAN UNIVERSE. Nowotny, Ekkehard (Univ., Konstanz, Ger.). Commun. Math. Phys.; 26: No. 4, 321-32(1972).

Within the framework of general relativity the Dirac equation for the hydrogen atom is given in case of a spatially isotropic and homogeneous expanding space-time (Robertson Walker metric). In the special case of the static, closed 3-dimensional spherical space (Einstein Universe) one obtains a continuous energy spectrum for the H-atom. (auth)

57447 CAUCHY PROBLEM FOR THE NONLINEAR BOLTZMANN EQUATION IN GENERAL RELATIVITY THEORY. Bancel, Daniel (Univ., Toulouse). Compt. Rend., Ser. A; 274: No. 26, 1967-9(26 Jun 1972). (In French).

The Cauchy problem for the nonlinear Boltzmann equation and for initial conditions similar to a Maxwellian distribution was studied. The existence of a solution in a regular space-time having a Maxwellian distribution solution of the Liouville equation is established. (France)

57448 NEW THEORY OF GRAVITATION. Yilmaz, H. (Perception Tech. Corp., Winchester, Mass.). Lett. Nuovo Cim.; 5: No. 4, 309-12(23 Sep 1972).

A closed exponential form for the iteration solution of a theory of gravitation is presented. This theory is not equivalent to the Einstein gravitational theory. This new theory offers the hope of constructing a gray hole model in which some of the current puzzles concerning quasars and pulsars could be explained. (J.F.P.)

57449 REPRESENTATIONS OF THE GAUGE GROUPS OF ELECTRODYNAMICS AND GENERAL RELATIVITY. Girardello, L.; Wyss, W. (Univ. of Colorado, Boulder). Helv. Phys. Acta; 45: No. 1, 197-202(1972).

A semidirect product of the gauge groups of electrodynamics and general relativity is determined and unitarity represented on a Hilbert space of the type L_2 ($\mathscr{L}'$,μ). (auth)

57450 RELATIVISTIC RUNAWAY PROBLEM. Noerdlinger, P. D. (Michigan State Univ., East Lansing). Nature (London) Phys. Sci.; 239: No. 88, 9-10(4 Sep 1972).

In Newtonian theory if a test particle is in a circular orbit around a central mass m, and m decreases suddenly to half or less of its original value, the test particle escapes. Corrections due to general relativity considerations are, however, discussed. (UK)

57451 GRAVITATIONAL FIELD OF SIMPLE SPHERICAL ROTATING SHELLS IN THE LINEAR APPROXIMATION. Teyssandier, P. (Institut Henri Poincare, Paris). Lett. Nuovo Cim.; 5: No. 4, 359-65(23 Sep 1972). (In French).

A calculation is made of the gravitational field of a simple rotating spherical shell of which the surface density depends on the colatitude. The determination of the potentials and the precession is obtained at all points of empty space from the systematic use of spherical harmonics. (J.F.P.)

57452 ELEMENTARY PARTICLES AND GENERAL RELATIVITY. Wynne, V. A.; Ross, D. K. (Memorial Univ. of Newfoundland, St. John's). Lett. Nuovo Cim.; 5: No. 4, 346-8 (23 Sep 1972).

It was previously claimed that a numerical value for the radius of the proton is obtained using the framework of general relativity. It is pointed out that the argument upon which this claim is based is incorrect. (J.F.P.)

57453 APPLICATIONS OF ALGEBRAIC MANIPULATION PROGRAMS IN PHYSICS. Barton, D.; Fitch, J. P. (Cambridge Univ., Eng.). Rep. Progr. Phys.; 35: No. 3, 235-314(1972).

The application to three areas of physics of computer programs that carry out formal algebraic manipulation is described. The application areas discussed are celestial mechanics, general relativity and quantum electrodynamics. Typical problems from each of these disciplines which can be solved using algebraic manipulative systems are described and sample programs for the solution of these problems are presented using several algebra systems. For each discipline a review of published work acknowledging the use of algebra programs is presented and the most advanced applications are discussed in detail. In particular the Lie transform, Petrov classification, and Kahane's simplification procedure are reviewed from the standpoint of algebra programs. A number of examples are given to indicate the capabilities of an algebra program, and a brief review of the technical problems of algebraic manipulation is given. Applications of such systems to mathematics, chemistry, and engineering are briefly mentioned but the main emphasis is placed on applications in the theoretical physics. However, the examples indicate, and the applications in the physical sciences confirm, that algebra systems are capable of exploitation over a much wider area than is covered in the present review. (auth)

57454 UNIQUENESS OF THE ELASTIC MASS TENSOR. Kuchina, T. M. (Kazakh State Univ., Alma-Ata, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 56-9(1972). (In Russian).

Starting with the gravitational equation in the general theory of relativity, there is formulated an elastic body of finite dimensions or a system of such bodies, using an energy-momentum tensor or a mass tensor of this body. In this particular treatment the uniqueness principle of V. A. Fok is used. (K.S.W.)

57455 RESONANT INTERACTIONS BETWEEN A TENSORIAL GRAVITATIONAL WAVE AND A SCALAR WAVE. Tourrenc, Philippe (Inst. Henri Poincare, Paris). Compt. Rend., Ser. A; 274: No. 25, 1857-60(19 Jun 1972). (In French).

A resonance phenomenon between a scalar wave and a gravitational wave is physically interpreted in the linear approximation. A method of calculating the phase shift is given for the case of a guided wave. (France)

57456 COVARIANT SCALAR THEORY OF GRAVITATION AND ITS IMPLICATIONS FOR GENERAL RELATIVITY. Pietenpol, J. L.; Speiser, D. (Univ. Catholique, Louvain, Belg.). Ann. Soc. Sci. Brux. Ser. I; 86: No. 2, 220-6(15 Aug 1972). (In French).

Attention is given to an old theory of gravitation which may not agree with experimental results but can nevertheless lead to a better understanding of general relativity theory. This theory can be written naturally and in a completely covariant form. But it is at the same time a simple modification of the potential scalar theory in special relativity. (J.F.P.)

57457 ANGULAR MOMENTUM IN GENERAL RELATIVITY AND THE KERR METRIC. Moss, M. K.; Davis, W. R. (North Carolina State Univ., Raleigh). Nuovo Cim.; 11B: No. 1, 84-92 (11 Sep 1972).

The field angular-momentum conservation law following from the Komar identity is formulated and, as an example, applied in detail to the computation of the total angular momentum of the Kerr metric. It is shown that the formulation and method used in this computation are simpler and much more straightforward than the approach of Cohen based on Trautman's formulation of the conservation laws. Also, a general discussion of the problem of the proper formulation of the angular-momentum conservation laws (when admitted) in general relativity, including considerations of the relevant symmetry properties, is given. The Komar and Trautman formulations of the conservation laws, in conjunction with appropriate symmetry considerations, are briefly contrasted. (auth)

57458 PERFECT FLUID DISTRIBUTION IN CLASS ONE SPACE-TIME. Pokhariyal, G. P. (Banaras Hindu Univ., India). Gen. Relativity Gravitation; 3: No. 2, 87-93(Jun 1972).

Space-times of class one for which the elementary divisors of the second fundamental tensor are real but not simple, do not admit perfect fluid distributions. (auth)

57459 SOME TOPOLOGICAL CONSIDERATIONS IN GENERAL RELATIVITY. Porter, John; Thompson, Alan. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 51: No. 3-4, 191-8(1972).

The consequences of the well known result that the Euler–Poincare characteristic of an Einstein–Lorentz manifold, M (a four-dimensional connected orientable C^∞-differentiable manifold) vanishes are discussed for general relativity theory. In particular the Weyl conformal curvature and energy–momentum tensors of a compact Einstein–Lorentz manifold are considered. It is shown that only a restricted class of manifolds can support a perfect-fluid or nonnull electromagnetic field and a necessary condition is given for M to admit a vacuum solution of the field equations. Some results concerning the Pontryagin number of M are also given. (J.F.P.)

57460 EXACT EQUATIONS FOR THE STATIONARY EQUILIBRIUM OF RELATIVISTIC ROTATING OBJECTS. Pachner, J.; Miketinac, M. J. (Univ. of Saskatchewan, Regina). Phys. Rev., D; 6: No. 6, 1479-86(15 Sep 1972).

Some properties of a special comoving coordinate system introduced earlier are discussed in the four-dimensional $g_{\mu\nu}$ metric as well as in the three-dimensional positive definite γ_{ik} metric of Landau and Lifshitz. A general form of the metric describing a stationary rotation in comoving coordinates is derived. The relativistic equation of hydrostationary equilibrium is deduced. In the γ_{ik} metric it may be reduced to the form expressing the equilibrium between a certain three-dimensional volume integral and the pressure gradients acting at the two-dimensional surface of the integration domain. The exact Einstein field equations for the stationary equilibrium of relativistic rotating objects are derived in the special comoving system of coordinates. They reduce to five partial differential equations of elliptical type for five unknown functions. It is shown that a rigid rotation can exist only for a certain spatial distribution of the vorticity vector. (auth)

57461 ELECTROMAGNETIC FIELDS AND MASSIVE BODIES. Wald, Robert M. (Princeton Univ., N. J.). Phys. Rev., D; 6: No. 6, 1476-9(15 Sep 1972).

An example of the effects of massive bodies on static electromagnetic fields in general relativity is considered which yields considerable insight into the fadeaway of multipole moments in nonspherical perturbations of gravitational collapse. The electromagnetic field of an electrostatic or magnetostatic multipole of fixed strength placed at the center of a massive, nonrotating, spherical shell is calculated. If a sequence of static solutions in which the massive shell approaches its own Schwarzschild radius is considered, it is found that except in the monopole ($l = 0$) case the value of the multipole moment measured by a distant observer goes to zero. Thus, for an arbitrary (but finite) stationary charge and current distribution inside the shell, in the limit as the shell approaches its Schwarzschild radius the only property of the distribution which can be measured by an external observer is the total electric charge. (auth)

57462 UPPER LIMIT ON THE GRAVITATIONAL FLUX REACHING THE EARTH FROM THE CRAB PULSAR. Levine, Judah (National Bureau of Standards, Boulder, Colo.); Stebbins, Robin. Phys. Rev., D; 6: No. 6, 1465-8(15 Sep 1972).

A 30-m laser interferometer was used in a search for gravitational radiation from the Crab pulsar. The minimum detectable signal would be produced by an incident gravitational flux of 10^9 ergs/sec cm^2 and no effect was found at this level. (auth)

57463 INDUCED GRAVITATIONAL WAVES. Ceapa, A. Phys. Lett.; 41A: No. 3, 252(25 Sep 1972).

The energy-momentum conservation laws allow a possibility to generate and detect microscopic gravitational waves of high frequencies. (auth)

57464 POLARIZATION OF PROTONS IN THE GRAVITATIONAL FIELD OF ROTATING OBJECTS. Vladimirov, Yu. S.; Iskhakov, I. F. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 158-60(1972). (In Russian).

A polarization effect on a beam of protons may occur during its passage (initially in an unpolarized state) through the classical gravitational field of a rotating central object, as shown by quantum field theory. Two special cases are treated relating to the orientation of the momentum of the central body with respect to the direction of the initial momentum of the protons. (K.S.W.)

Scattering Theory

Refer also to abstracts 57271, 57272, 57341, 57342, 57421, 57991, and 57995.

57465 (NP-19441) SINGLE PARTICLE DISTRIBUTIONS, DOUBLE DISCONTINUITIES, AND TRIPLE REGGE LIMITS. Rabl, Arnulf; Rabl, Veronika (Bonn Univ. (West Germany). Physikalisches Institut). Aug 1972. 14p. Dep. NTIS (U. S. Sales Only).

The constraints imposed by direct channel unitarity on the trajectories appearing in the helicity pole limit $s^{2\alpha(t)}$ $f(t,M^2)$ of the three-to-three body amplitude are investigated. The inequality $\alpha(t) \leq 3/4$ for $t \leqq 0$ is found independent of M^2, a bound which is incompatible with diffraction scattering. This result is indicated by general considerations and confirmed by specific models, in particular the dual resonance model and several ϕ^3 ladder graphs. (auth)

57466 NECESSITY OF TAKING INTO ACCOUNT THE SECOND-ORDER TERMS OF THE DISTORTED WAVE METHOD IN THE PROBLEM OF THREE PARTICLE SCATTERING. Potapov, V. S. (Moscow State Univ.). Yadern. Fiz.; 16: No. 1, 81-7(Jul 1972). (In Russian).

It is shown that correct asymptotics of three-particle scattering amplitude with reconstruction in the limits of high velocity of incident particle in the method of distorted waves can be obtained only by taking into account the second-order terms as well as the first-order ones. (auth)

57467 GEOMETRICAL INTERPRETATION OF THE HARMONIC ANALYSIS OF THE SCATTERING AMPLITUDE. Viano, G. A. (Univ., Genoa). Commun. Math. Phys.; 26: No. 4, 290-300(1972).

The geometry underlying the various representations of the relativistic scattering amplitudes is analyzed. More precisely the direct-channel expansion, its euclidean contraction and the crossed-channel representation are considered. In all these representations one can distinguish the factors which express the dynamics from those which reflect the symmetry; starting from the latter, one can try a geometrical interpretation of the harmonic analysis of the scattering amplitude on the Poincaré group. (auth)

57468 ALGEBRAIC CURVE THEORY AND THE ENVELOPE DIAGRAMS. Abhyankar, Shreeram (Purdue Univ., Lafayette, Ind.); Risk, Clifford. pp 15-25 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

Algebraic curve theory is applied to the analysis of the nodes and cusps of the Landau curves for the double scattering function and the open envelope diagram. The results complete the proof of the validity of the Mandelstam representation for each diagram. (auth)

57469 CONSISTENCY PROBLEMS IN S MATRIX THEORY. Eden, Richard J. (Cavendish Lab., Cambridge, Eng.). pp 135-48 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

The problem of mapping a scattering amplitude on to the (complex) space of the kinematic invariants associated with energy and momentum transfer is treated. The mapping can be studied by means of phase contours, which are curves or surfaces on which the phase of the scattering amplitude is real constant. The method is illustrated by a Regge model in which consistency under crossing symmetry leads to information about zeros of the scattering amplitude. The related complex surfaces of zeros indicate analytic relations between: (a) zeros of Regge residues, (b) zeros associated with generalized scattering lengths, (c) zeros of Legendre polynomials associated with resonances, and (d) zeros arising from interference between resonance poles. (auth)

57470 SCATTERING THEORY IN GENERAL QUANTUM MECHANICS. Jauch, J. M. (Univ., Geneva). pp 185-205 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

Some preliminary results concerning scattering theory in lattice theoretical formulation are presented. An attempt is made to formulate an asymptotic condition and to obtain a proof for the existence of the lattice theoretic analogues of the Moeller wave operators and the scattering operator. Some of the notions that permit the transcription of the asymptotic condition into general quantum mechanics are provided. Some of the outstanding problems are identified. (L.B.S.)

57471 EXTENSION OF ANALYTICITY DOMAINS OF FUNCTIONS WITH POSITIVITY PROPERTIES AND AXIOMATIC PROOF OF SUPERCONVERGENCE RELATIONS. Mahoux, Gilbert; Martin, Andre (State Univ. of New York, Stony Brook). pp 265-77 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

It is first shown that scalar two-body—two-body scattering amplitudes, which are known from axiomatic local field theory to satisfy dispersion relations for real negative transfer $-t_0 \leq t \leq 0$, and to be analytic in the Lehmann ellipse, are indeed analytic in a larger domain, and satisfy dispersion relations in a circle $|t| < R$. This analytic completion makes a crucial use of the positivity properties due to unitarity condition. The nontrivial extension of this result to the scattering spin particles is done using helicity formalism. As a consequence, the Froissart bound for any helicity amplitude is obtained, and an axiomatic proof of the superconvergence properties is given. (auth)

57472 JOST FUNCTION AS AN ANALYTIC FUNCTION OF THE COUPLING CONSTANT. Frank, William M. (Naval Ordnance Lab., Silver Spring, Md.). pp 435-41 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

The Jost solution for the wave equation of the lth partial wave is given for a spherically symmetric piece-wise continuous potential and it is shown that the Jost function is an analytic function of the coupling constant. The behavior of the Jost function and corresponding scattering quantities for a different class of potentials are also noted. (L.B.S.)

57473 LEGENDRE SERIES IN POTENTIAL SCATTERING THEORY. Walter, Gilbert (Univ. of Wisconsin, Milwaukee). pp 553-6 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

The behavior of the scattering amplitude $A(k,z)$ was previously investigated by studying the Legendre series $\Sigma a_n(k)\ P_n(z) = A(k,z)$, using the method of Nehari to obtain information about the locations of singular points of $A(k,z)$ by comparing them to the locations of singular points of the power series $\Sigma_{n=o}^{\infty} a_n(k)z^n = B(k,z)$. This method involves expressing each of $A(k,z)$ and $B(k,z)$ in terms of the other by means of an integral operator. Two procedures are introduced for resolving the case where the Legendre series does not converge to an analytic function. The first method is an extension of the Nehari method; it locates the singular points of the analytic representation of $A(k,z)$ by relating this function to $B(k,z)$. The second method uses a different notion of singular point. Both methods are valid when $a_n(k) = o(n^P)$ for some integer P and thus may be applied to Coulomb and inverse square potentials. (L.B.S.)

57474 PROPER SINGULARITIES OF ONE LOOP n-ANGLES FEYNMAN DIAGRAMS. Kuznetsov, G. I. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 15: No. 4, 846-8(Apr 1972). (In Russian).

One-loop n-angle diagrams are shown to be determined by the derivatives of the 5-angle reduced diagrams and consequently have their inherent singularities in addition to the singularities of 5-angle diagrams. (auth)

57475 SCATTERING AMPLITUDES IN THE BLOCH—NORDSIECK MODEL FIELD THEORY. Maheshwari, A. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 5: No. 4, 349-54(23 Sep 1972).

It is shown that the elastic scattering amplitude in the Bloch—Nordsieck model is in eikonal form. Inelastic scattering amplitudes are also studied in this model. (J.F.P.)

57476 S-WAVE EIGENVALUES OF THE LIPPMANN—SCHWINGER KERNEL FOR THE EXPONENTIAL POTENTIAL. Stern, M. S.; Warburton, A. E. A. (Univ. of Hull, Eng.). J. Phys., A (London); 5: No. 8, 1233-5(Aug 1972).

It is shown that the S-wave eigenvalues of the Lippmann—Schwinger kernel for the exponential potential can be determined from the zeros of a Bessel function whose order is energy dependent. An asymptotic expansion is obtained for the leading eigenvalue at negative energies. (auth)

57477 MATRIX ELEMENTS AND CORRESPONDENCE PRINCIPLES. Naccache, P. F. (Univ. of Stirling, Eng.). J. Phys., B (London); 5: No. 7, 1308-19(Jul 1972).

Heisenberg's form of the correspondence principle for nonrelativistic matrix elements was used to evaluate matrix elements for various potentials. These are compared with available quantum mechanical results to check the general validity of the use of classical mechanics and correspondence principles in the derivation of quantum mechanical expressions. Using a one dimensional harmonic oscillator potential, matrix elements of the form $\langle n|q^m|n+s\rangle$ and $\langle n|p^m|n+s\rangle$ are worked out. A Morse potential is then considered and the matrix elements for position, momentum, and kinetic energy are evaluated. Using a Coulomb potential a similar procedure is used for functions of various position coordinates, from which dipole and quadrupole moments from transitions between n, 1 states are calculated. The agreement with quantum mechanics is found to be generally good, and in some cases identical results are obtained. (auth)

57478 BOUND STATES IN THE STRONG COUPLING LIMIT. Martin, Andre (CERN, Geneva). Helv. Phys. Acta; 45: No. 1, 140-8(1972).

It is shown that the number of bound states of a particle in a short-range potential in n dimensions is given asymptotically by $N = \{g^{n/2} [S_n/(2\pi)^n] \int |2MV^-/\hbar^2|^{n/2} d^nx + 0(g^{n/2-\varepsilon})\}$ for $g \to \infty$, where gV^- is the attractive part of the potential, and S_n is the volume of the n dimensional sphere with unit radius. (auth)

57479 LOCAL ANALYTICITY PROPERTIES OF THE n PARTICLE SCATTERING AMPLITUDE. Bros, J. (CERN, Geneva); Glaser, V.; Epstein, H. Helv. Phys. Acta; 45: No. 1, 149-81(1972).

The connected part $F_c(p)$ of the scattering amplitude $\langle p_1 \ldots p_r |S-1| p_{r+1}, \ldots, p_n\rangle$ defined on the mass shell $p_i^2 = m_i^2$ and deduced from a local field theory involving only (stable) particles with strictly positive masses can be represented in a suitable neighborhood of any physical point p as a finite sum $f_c(p) = \Sigma_1^N F_i(p)$ of "partial amplitudes", each $F_i(k)$ analytic in a certain domain F_i of the complex mass shell $k_i^2 = m_i^2$. The mentioned real neighborhood lies on the boundary of each F_i. The above decomposition may fail to hold only at points p where any two incoming or any two outgoing four-momenta become parallel (thresholds). The number N as well as the shape of the domains F_i depend on the number n and on the real neighborhood considered. For a generic configuration p the intersection of the domains F_i is empty. When this does not happen, $F_i(p)$ is the boundary value of a single analytic function. This is illustrated on the case of the five-point function, where it is shown that when $D \equiv \det(p_r p_s) > m_1^2 m_2^2 m_3^2$, D being the Gram determinant of the scalar products of the three outgoing momenta p_1, p_2, p_3, the scattering amplitude is the boundary value of a single analytic function. It is also indicated on the same example how these local results may be improved; one finds in the equal mass case $m_r = m$ that the five-point scattering amplitude is the boundary value of a single analytic function whenever $M > 4, 8m$, M being the total center-of-mass energy of the three outgoing momenta. (auth)

57480 COUPLED FORM FACTORS IN TWO-CHANNEL PROBLEMS. Kreuzer, H. J.; Kamal, A. N. (Univ. of Alberta, Edmonton). Phys. Rev., D; 6: No. 6, 1638-47(15 Sep 1972).

The problem of coupled (S-wave) form factors is formulated in the two-body two-channel spinless case. Iterative and exact numerical solutions of coupled integral equations are presented with model parametrizations of the T matrix. The problem of diagonalization is discussed and the difficulties are highlighted. A method of solution for the weak coupling to first order in T_{12} is presented. (auth)

57481 TIME DELAY IN QUANTUM SCATTERING. Nussenzveig, H. M. (Univ. of Rochester, N. Y.). Phys. Rev., D; 6: No. 6, 1534-42(15 Sep 1972).

A new definition of the time delay in the scattering of a quantum-mechanical wave packet is proposed. It has a broader domain of applicability than previous definitions. The average time delay for the scattering of a plane-wave train is evaluated. Applications of the result to the quantum theory of the second virial coefficient are given. (auth)

57482 $\pi\pi$ PHENOMENOLOGY BELOW 1100 MeV. Basdevant, J. L.; Froggatt, C. D.; Petersen, J. L. (CERN, Geneva). Phys. Lett.; 41B: No. 2, 178-82(18 Sep 1972).

Conclusions are presented that can be drawn from combining all present experimental information on low energy $\pi\pi$ scattering with the requirements of crossing, unitarity and analyticity. (auth)

57483 OFF-SHELL EXTENSION OF THE PARTIAL-WAVE TRANSITION AMPLITUDE. Karlsson, Bengt R. (Stanford Univ., Calif.). Phys. Rev., D; 6: No. 6, 1662-9(15 Sep 1972).

The Marchenko approach to the inverse problem of scattering theory is transformed into a procedure for the calculation of the (half-) off-shell partial-wave transition amplitude from the on-shell amplitude and certain bound-state parameters. (auth)

57484 HIGH-ENERGY SCATTERING IN ϕ^3 THEORY AND THE BREAKDOWN OF EIKONAL APPROXIMATION. II. Cheng, Hung (Massachusetts Inst. of Tech., Cambridge); Wu, Tai Tsun. Contract AT(11-1)-3227. Phys. Rev., D; 6: No. 6, 1693-1701 (15 Sep 1972).

In ϕ^3 theory, the high-energy amplitudes for the exchange of two or more ladders are studied. These amplitudes are obtained in closed forms to all orders of the coupling constant. The conclusions are as follows: (i) All of the scattering amplitudes satisfy the impact-factor representation. (ii) Except for the leading term (in the coupling constant) the scattering amplitude of two-ladder exchange is not in the form dictated by the eikonal approximation. (iii) The scattering amplitudes for the exchange of N ladders, $N \geq 3$, are never in the form dictated by the eikonal approximation — even for the leading term. (When the coupling constant approaches zero, all of them are of the order of s^{-3} instead of s^{-2N+1}, as dictated by the eikonal approximation.) Thus the eikonal approximation is not valid in ϕ^3 theory. The amplitude for the exchange of n scalar mesons, $n > 4$, is also given. Contrary to the popular notion, it is not of the order of s^{-n+1} when $n > 4$. Summing over such amplitudes does not lead to the exponentiation form commonly conceded in the past. (auth)

57485 FADDEEV–LOVELACE EQUATIONS IN THE EIKONAL APPROXIMATION. Janev, R. K. (Inst. of Physics, Belgrade); Salin, A. Ann. Phys. (N. Y.); 73: No. 1, 136-55(Sep 1972).

The three-body problem with two heavy particles and a light one is considered. It is shown that the Faddeev–Lovelace equations can be simplified by using the eikonal approximation. Two coupled integral equations are obtained, the potential between the heavy particles being accounted for with the help of the distorted wave method. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

57486 COUPLING FROM SECOND TO FIRST SOUND IN UNIFORMLY ROTATING LIQUID HELIUM. Lucas, P.; Hillel, A. J. (Univ. of Manchester, Eng.). J. Phys., C (London); 5: No. 7, 721-31(13 Apr 1972).

The magnitude of the coupling from second sound to first sound predicted by Hall (J. Phys. C: Solid State Phys. 3:1166-79, (1970)) in uniformly rotating liquid He II is calculated for a cavity with rectangular geometry. The amplitude of the effect is calculated to be an order of magnitude smaller than that due to the finite thermal expansion coefficient of liquid helium in an experimental cavity. This latter type of coupling has been detected in experiments using this cavity but the measurements are not yet sufficiently precise to check Hall's prediction. (auth)

57487 FOCUSING BEAMS OF CHARGED VORTEX RINGS. Hess, G. B. (Univ. of Virginia, Charlottesville). Phys. Lett.; 41A: No. 3, 275-6(25 Sep 1972).

It is shown that standard types of electrostatic lenses should be suitable for focusing beams of charged vortex rings in liquid helium II. The converging power may be greater or less than for ordinary particles, depending on the type of lens. (auth)

57488 PHENOMENOLOGY OF VORTICES IN SUPERFLUID HELIUM. Putterman, Seth (Univ. of California, Los Angeles). Phys. Rep.; 4C: No. 2, 67-94(Jul 1972).

The major reason for interest in superfluid helium lies in its unusual macroscopic properties. Although quantum theory is essential for an understanding of these properties of only clearly established manner in which Planck's constant enters the macroscopic behavior is through the Onsager–Feynman quantization of the circulation (or vorticity) of the superfluid velocity. Thus vortices play a crucial role in the understanding of superfluid helium and for this reason a review of the basic phenomenological theory and experiments relating to vortices in He II is presented. (auth)

57489 KAPITZA RESISTANCE AND THIN SURFACE FILMS. Whelan, Michael F.; Osborne, Donald V. (Univ. of East Anglia, Norwich, Eng.). J. Low Temp. Phys.; 8: No. 5-6, 449-61(Sep 1972).

Experimentally observed values for the Kapitza resistance across a solid–liquid He II boundary show that for specimens of gold, copper, and sapphire an enhanced heat flow is achieved between the two media if a surface film of barium stearate is deposited on the solid. The magnitude of the improved heat flow is less than that predicted from a simple model for phonon transmission across a solid/film/liquid arrangement, but is greater than that expected from the Khalatnikov theory. (auth)

57490 SATURATION OF FLUCTUATION DISSIPATION IN SUPERFLUID FLOW. Campbell, L. J.; Liebenberg, D. H. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett.; 29: No. 16, 1065-7(16 Oct 1972).

In a thermally driven superfluid helium film the dissipation was observed to saturate for sufficiently high superfluid velocity, in agreement with the fluctuation model of intrinsic dissipation. (auth)

57491 FORCE EXERTED BY CHARGED VORTEX RINGS. Huggins, Elisha R. (Kyoto Univ.). Phys. Rev. Lett.; 29: No. 16, 1067-70(16 Oct 1972).

The force observed by Gamota and Barmatz, which is exerted upon the flexible diaphragm by a stream of charged vortex rings in superfluid helium, is shown to arise from the electric force applied to the rings rather than an impulse carried by the rings. Consequently, the diaphragm should not be a sensitive detector of uncharged vortices. Underlying the analysis is the fact that the charged rings do not obey the Helmholtz–Kelvin circulation theorem. (auth)

57492 PROPER ANALYSIS OF EXPERIMENTS ON QUANTIZED, CHARGED VORTEX RINGS IN SUPERFLUID HELIUM. Wong, K. W.; Meyer, W. (Univ. of Southern California, Los Angeles). Nuovo Cim.; 11B: No. 1, 155-66(11 Sep 1972).

The equations governing the electromagnetic-field dependence of the quantized charged vortex rings created in superfluid helium with usual experimental set-ups and with both electric and magnetic fields assumed to be parallel are derived. These equations are then applied to analyze a set of experimental results. The conclusion shows positively the existence of pair-condensate in superfluid helium. (auth)

57493 VORTICES. Volger, J. (Philips Research Labs., Eindhoven, Netherlands). Philips Tech. Rev.; 32: No. 6-8, 247-58(1971).

Analogies are pointed out between vortices encountered in different physical systems. Some results of vector analysis are mentioned, together with a few principles of the theory of electricity. Vortices in liquids, dislocations in crystals, flux lines in superconductors, and vortices in superfluid helium are then discussed. Some results of recent investigations are mentioned, such as the explanation by Haug and Weiss of the difference in thermal contact between liquid helium and a solid (Kapitza resistance) found with different materials, the emission (and absorption) of microwaves by an array of Josephson contacts (Clark) and the vortex refrigerator by Staas and Severijns. (25 references) (auth)

Superconductivity

Refer also to abstracts 56700, 56707, 56837, 56839, 56841, 57493, and 57944.

57494 (CONF-720833–7) EFFECTS OF SOME 3d AND 4d SOLUTES ON THE SUPERCONDUCTIVITY OF TECHNETIUM. Koch, C. C.; Gardner, W. E.; Mortimer, M. J. (Oak Ridge National Lab., Tenn.). 1972. 13p. Dep. NTIS.

From 13th international conference on low temperature physics; Boulder, CO. (20 Aug 1972).

Results are presented of an experimental study of changes in the superconducting transition temperature, magnetic susceptibility, and electrical resistivity of technetium with concentrations of up to about 5 at.% Cr, Fe, Co, or Ni (3d magnetic solutes) as well as Ru (a 4d nonmagnetic solute). (M.H.R.)

57495 (JINR–P8-6584) STRUCTURE OF AN ABRIKOSOV EDDY NEAR A SUPERCONDUCTOR SURFACE. Danilov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

The electromagnetic structure of an Abrikosov eddy was investigated on the basis of a joint solution to Maxwell's equations and the generalized equations of London. The eddy structure was oriented at an arbitrary angle to the planar surface of a Type-II superconductor (the Ginsburg–Landau parameter $\kappa \gg 1$). The influence of the electromagnetic structure of the eddies in the surface layer on their mutual interaction was determined. (tr-auth)

57496 EXACT SOLUTION OF THE MODEL OF BARDEEN–COOPER–SCHRIEFFER. Bernadskii, I. A.; Minlos, R. A. (Moscow State Univ.). Teor. Mat. Fiz.; 12: No. 2, 227-38 (Aug 1972). (In Russian).

An exact solution of a variant of the BCS model is given. The character of the ground state and the spectrum of elementary excitations are investigated (in particular, the values of the parameters of the system are pointed out, at which there exists a gap between the spectrum mentioned and the ground state) and the statistical sum is evaluated. The method of the solution is based on a certain special representation of the BCS Hamiltonian which was, in its simplest form, proposed in the papers by Anderson [Phys. Rev., 112: 1900, (1958)] and one of the authors [Minlos, Zh. Eksp. Teoret. Fiz., 50: 642 (1966)]. (auth)

57497 SURFACE IMPURITIES AND THE SUPERCONDUCTING-TO-NORMAL TRANSITION: THEORY. Green, I. M.; Hlawiczka, P. (Univ. of Glasgow). J. Phys., D (London); 5: No. 5, 1005-15(May 1972).

The variation of the superconducting-to-normal transition field as a function of temperature is evaluated for superconductors having impurities which vary in density through a thin surface layer. Numerical results are obtained for tantalum, in which impurities cause the appearance of a tail to the M–H curve above H_{c} The precise shape of the tail is also evaluated. (auth)

57498 SURFACE IMPURITIES AND THE SUPERCONDUCTING-TO-NORMAL TRANSITION: EXPERIMENTS ON TANTALUM. Green, I. M.; Hlawiczka, P. (Univ. of Glasgow). J. Phys., D (London); 5: No. 5, 1016-26(May 1972).

Measurements of the S–N transition and M–H curves of a tantalum sample impregnated with hydrogen are reported. Results are in excellent agreement with the theory previously reported and show the effect on superconducting properties of an impure layer near the surface of an otherwise pure and strain-free sample. A profile of the impurity concentration near the surface is derived, as measured by the local value of κ. (auth)

57499 MAGNETIC HYSTERESIS IN TYPE II SUPERCONDUCTORS. Inhaber, H. (Univ. of Oklahoma, Norman). Solid State Commun.; 11: No. 4, 535-8(15 Aug 1972).

The theories governing the magnetic behavior of Type-II superconductors assume reversible magnetization curves. However, due to imperfections and inhomogeneities, many superconductors possess hysteretic curves. A theory is proposed which allows a reversible curve to be found from the two irreversible curves. The reversible curve is an approximation to the exact Abrikosov reversible curve for $H_{c1} \leq H \leq H_{c2}$. The theory agrees closely with experimental results. (auth)

57500 CRITICAL MAGNETIC FIELD OF STRONG COUPLING SUPERCONDUCTORS. Vashishta, P. (Argonne National Lab., Ill.); Carbotte, J. P. Solid State Commun.; 11: No. 4, 539-42 (15 Aug 1972).

New results for the temperature variation of the thermodynamic critical magnetic field of four strong-coupling superconductors are presented. Amorphous Ga, for which the calculated temperature variation of the reduced gap, $\Delta_0(T)/\Delta_0(0)$, shows largest deviations from the BCS predictions exhibits the smallest deviations in D(t) among the four materials. The strongest deviations are found to occur in the alloy $Pb_{0.9}\ Bi_{0.1}$, where they are nearly one and a half times as large as the ones calculated in Pb. (auth)

57501 HYSTERETIC MODEL IN A HARD SUPERCONDUCTOR. Inhaber, H. (Univ. of Oklahoma, Norman). Solid State Commun.; 11: No. 4, 583-5(15 Aug 1972).

A theory of hysteresis in superconductors based on an approximation to the fluxoid–fluxoid interaction is used to fit experimental data on highly hysteretic Nb wires. No adjustable parameters were used in the comparison, but only data pertaining to the shape of the magnetization curves. The qualitative agreement of the calculated and experimental curves is good, and quantitative agreement is reached on the curve of increasing field. (auth)

57502 DIRECT OBSERVATION OF CURRENT-INDUCED MOTION OF THE LANDAU DOMAIN STRUCTURE. Huebener, R. P. (Argonne National Lab., Ill.); Kampwirth, R. T.; Farrell, D. E. Phys. Lett.; 41A: No. 2, 105-6(11 Sep 1972).

Uniform motion of the Landau domain structure under the influence of an electric transport current was observed in Pb using a magneto-optic method. (auth)

57503 DEPENDENCE OF CRITICAL SUPERCURRENT ON NORMAL LAYER THICKNESS IN S/N/S STRUCTURES. Vassilev, P. G. (Univ. of Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 4, 459-62(1972).

The problem of the existence of supercurrents in symmetric S/N/S structures, depending on the thickness of the normal layer in the case of $d_n < \xi_n$ and $d_s > \xi_s$, is treated without making use of the diffusion formula, but merely by developing the coupling potential in order around the plane of symmetry. (L.M.T.)

57504 EFFECT OF FLUCTUATIONS IN SUPERCONDUCTING LAYERED COMPOUNDS. Cyrot, M. (Paris Univ., Orsay, France). Solid State Commun.; 11: No. 5, 747-9(1 Sep 1972).

A new mechanism of spin–lattice relaxation due to fluctuations is described. It would enable the study of fluctuations in superconducting layered compounds. (auth)

57505 SUPERCONDUCTIVITY OF CuS SEMICONDUCTOR FILM. Aliev, F. Yu.; Kerimov, I. G.; Godzhaev, F. P.; Kalinina, E. I.; Krupnikov, E. S. Dokl. Akad. Nauk Azerb. SSR; 27: No. 9, 18-19(1971). (In Russian).

Superconductivity was observed in CuS semiconductor film having thickness 6×10^{-6} cm at°K. (auth)

57506 PROPERTIES OF HIGH-FIELD SUPERCONDUCTORS CONTAINING LOCALIZED MAGNETIC MOMENTS. Fischer, Oeystein H. (Univ., Geneva). Helv. Phys. Acta; 45: No. 3, 331-97(31 Aug 1972).

The problem of paramagnetic impurities in high field superconductors is analyzed. Special emphasis is put on the effects that appear when the impurity spins align in an external field or due to interactions. The impurities then produce an exchange field on the conduction electron spins which in some cases may counteract the effect of the external field on the conduction electron spins. In such cases the critical field of the dilute alloy may rise above the value of the pure system and the phase boundary $H_{c_2}(T)$ will have an anomalous shape. This effect is discussed theoretically in detail and experimental results on the system $Mo_{1-x}M_xGa_4$ (M = Nb, Ru, Mn, Fe, Co) are presented. (100 references) (auth)

57507 FORCE FREE MAGNETIC FIELDS IN A TYPE II SUPERCONDUCTING CYLINDER. Walmsley, D. G. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., F (London); 2: No. 3, 510-28(May 1972).

The macroscopic theory of force-free magnetic fields in the mixed state of type-II superconductors is presented. Solutions for cylindrical geometry are compared with experimental data from a Pb–40 at.% Tl alloy. In the experiments the sample is subjected to combinations of field and current in a longitudinal configuration and both axial magnetization and axial resistance are simultaneously monitored. The observed paramagnetic moment is in good agreement with the predictions. An unexpected feature of the experimental results is the appearance of flux-flow resistance at high currents. Coupled magnetic and resistive oscillations and discontinuities are observed in the flux-flow regime. The system is magnetically irreversible in the resistanceless state and reversible during flux flow. The results are discussed in the context of force-free field theory. (auth)

57508 QUASI-PARTICLE INTERFERENCE CURRENT IN JOSEPHSON JUNCTIONS. Poulsen, U. K. (Technical Univ. of Denmark, Lyngby). Phys. Lett.; 41A: No. 3, 195-6(25 Sep 1972).

The quasiparticle–pair interference current predicted by Josephson and recently observed directly is evaluated as a function of temperature and voltage. The results presented here are in quantitative agreement with the experimental observations. (auth)

57509 ELECTRONIC THERMAL CONDUCTIVITY OF SUPERCONDUTING THIN FILMS OF LEAD–INDIUM ALLOY. Gupta, A. K.; Wolf, S.; Chandrasekhar, B. S. (Case Western Reserve Univ., Cleveland). Phys. Lett.; 41A: No. 3, 265-6(25 Sep 1972).

The thermal conductivity of thin films of superconducting Pb–3 at. % In alloy was measured in the normal and the superconducting states. The ratio of the electronic thermal conductivity in the superconducting state K_{es} to that in the normal state K_{en} is found to be in good agreement with the Bardeen, Rickayzen, and Tewordt theory with $2\epsilon_o = 4.36\ kT_c$. (auth)

57510 TUNNELING INTO A HIGH-T_c SUPERCONDUCTOR—Nb_3Sn. Shen, L. Y. L. (Bell Labs., Murray Hill, N.J.). Phys. Rev. Lett.; 29: No. 16, 1082-6 (16 Oct 1972).

Tunnel junctions were fabricated on Nb_3Sn films reacted on Nb substrates. Derivative measurements were made from 0 to 50 MeV and above 18 K. From these tunneling results, the phonon spectrum of Nb_3Sn is shown to have a strong low-energy peak at 9 MeV, a broad peak centered around 17 MeV, and a small peak at 25 MeV. Using this shape of the phonon spectrum and taking $\mu^* = 0.11$, a maximum T_c of ~21 K is obtained for this class of superconductors. This result suggests that crystal transformations arising from instabilities do not limit T_c in this case. (auth)

57511 SUPERCONDUCTING TRANSITION OF A SILVER SOLDER ALLOY AT VERY LOW TEMPERATURES. Landau, Judah; Rosenbaum, Ralph (Technion, Haifa, Israel). Rev. Sci. Instrum.; 43: No. 10, 1540(Oct 1972).

The superconducting transition of a silver solder alloy was detected at 64.4 mK. This will make the alloy unsuitable as a medium for thermal contact at ultralow temperatures and may interfere with magnetic thermometry. (auth)

57512 INVESTIGATION OF PINNING SITES IN SUPERCONDUCTORS BY MEANS OF ALTERNATING CURRENTS. II. EXPERIMENTS. Lowell, J. (Univ. of Manchester, Eng.). J. Phys., F (London); 2: No. 3, 559-73(May 1972)

A small alternating current is passed through a slab of type-II superconductor in the mixed state, and the resulting alternating voltage is measured. Analysis of the observations enables the distribution, density, and strength of pinning sites to be deduced with the help of a simple model previously developed, providing that the assumptions of this model hold good. The validity of this model can be checked experimentally. In the case of a PbIn sample, properties of the pinning sites deduced from experiment are consistent with the assumption that pinning is due to second-phase precipitates. Measurements on cold-rolled NbTa cannot be successfully analyzed, probably because the analysis is valid only in the case of widely separated pinning sites. (auth)

57513 INVESTIGATION OF PINNING CENTRES IN SUPERCONDUCTORS BY MEANS OF ALTERNATING CURRENTS. I. THEORY. Lowell, J. (Univ. of Manchester, Eng.). J. Phys., F (London): 2: No. 3, 547-58(May 1972).

The interaction between the fluxon lattice and a random array of pinning sites can be analyzed with the help of a simple model. The critical current calculated from the model corresponds to the more refined calculation of Labusch (Crystal Lattice Defects. 1.1-16 (1969)). The model is used to analyze the response of a fluxon lattice to very small forces. It is shown that the displacement of the fluxon lattice is reversible and linear in the applied force up to a certain maximum displacement. Measurement of the displacement due to small forces can be performed by measuring the electric field in a slab carrying a small alternating current. Such measurements can yield useful information about pinning centres. (auth)

57514 FORCE FREE MAGNETIC FIELDS IN A TYPE II SUPERCONDUCTING SPHERE. Walmsley, D. G. (Atomic Energy Research Establishment Harwell, Eng.). J. Phys., F (London); 2: No. 3, 529-46(May 1972).

Solutions for the magnetic flux configuration inside a current-carrying Lorentz-force-free superconducting sphere are presented. Experiments were conducted on a 0.95 cm diameter Pb–40 at. % Tl sphere at 4.2 K in which the sphere is subjected to a range of fields (0 to H_{c2}) and currents (0 to 1000 A) in a longitudinal configuration, to test its behavior against the theoretical predictions. Axial magnetization is found to be in quite good agreement with the calculated values. Polar potential probes show, however, that a flux flow resistance occurs over a wide range of current and field values. An attempt to compress flux isotropically into the sphere so as to establish a final configuration in which there is no current across the sphere surfaces, but in which the field is stronger in the interior than that applied, was unsuccessful. This inability to establish a metastable state led to the conclusion that the order of application of field and current constraints has no influence on the final configuration achieved. (auth)

57515 ANALOG COMPUTER STUDIES OF SUBHARMONIC STEPS IN SUPERCONDUCTING WEAK LINKS. Hamilton, C. A.; Johnson, E. G. Jr. (National Bureau of Standards, Boulder, Colo.). Phys. Lett.; 41A: No. 4, 393-4(9 Oct 1972).

Microwave radiation applied to certain types of Josephson junctions produces steps in the V–1 curve at voltages corresponding to subharmonics of the applied radiation. Analog studies show the existence of these steps to be strongly dependent on reactive elements connected to the junction. (auth)

57516 CRITICAL CURRENT OF TIN JOSEPHSON JUNCTIONS. Paley, S.; Wilson, J.; Gayley, R. I. (State Univ. of New York, Buffalo). Phys. Lett.; 41A: No. 4, 311-12(9 Oct 1972).

The tin/tin oxide/tin Josephson junctions show critical currents that are closer to the BCS value than any reported previously and that are larger than the predictions of strong-coupling theory. (auth)

57517 LOW-TEMPERATURE X-RAY INVESTIGATION OF TECHNETIUM AND THE Tc–Mo A15 COMPOUND. Marples, J. A. C. (Atomic Energy Research Establishment, Harwell, Eng.); Koch, C. C. Phys. Lett.; 41A: No. 4, 307-8(9 Oct 1972).

X-ray investigations between 4.2 and 298 K have shown that technetium maintains its hcp structure down to 4.2 K with a nearly constant axial ratio, and that no tetragonal distortion occurs in this temperature range in a Tc–40 at. % Mo alloy which is an A-15 Type II superconductor. (auth)

57518 NEW EXPERIMENTAL TECHNIQUE FOR DETERMINING THE BCS INTERACTION PARAMETER IN NORMAL METALS. Clarke, J.; Freake, S. M.; Rappaport, M. L.; Thorp, T. L. (Univ. of California, Berkeley). Solid State Commun.; 11: No. 5. 689-93(1 Sep 1972).

The resistance of Pb/Ir/Pb sandwiches in the range 50 mK to 7°K was measured. The drop in resistance as the temperature is lowered towards the transition temperature of the Ir is in agreement with the prediction of a simple model involving the BCS parameter (NV). The model suggests that this technique applied to other metals would enable a value of (NV) as low as 10^{-3}, corresponding to a transition temperature of 10^{-4}°K, to be detected. (auth)

57519 IMPROVEMENTS IN OR RELATING TO SUPERCONDUCTIVITY DEVICES AND THEIR MANUFACTURE. Howlett Brian Wilfred (to United Kingdom Atomic Energy Authority). British Patent 1,281,514. 12 Jul 1972. Filed 2 Jul 1968.

The manufacturing method described consists of ion implanting a material into a substrate so as to form a region in the substrate with superconducting properties, or where the substrate is already superconductive, a region with modified superconducting properties. The ion-implanted material may be capable of forming a superconductive precipitation alloy by suitable heat treatment. An example described comprises formation of superconducting Nb_3Sn by ion implantation of Sn into Nb. (UK)

57520 SUPERCONDUCTIVITY OF $NbSe_2$ TO 140 KBAR. Smith, T. F. (Univ. of California, La Jolla); Delong, L. E.; Moodenbaugh, A. R.; Geballes, T. H.; Schwalls, R. E. J. Phys., C (London); 5: No. 16, L230-2(21 Aug 1972).

The superconducting transition temperature of $NbSe_2$ was measured as a function of hydrostatic pressure to 20 kbar and quasi-hydrostatic pressure to 140 kbar. At first T_c increased rapidly, but by 35 kbar the rate of increase fell by an order of magnitude from its initial value and then remained constant to the maximum pressure. It is suggested that this change in slope is associated with the phase change which occurs in the vicinity of 33 kbar at room temperature and that T_c is related to the interlayer spacing. (auth)

57521 PHONON FLUORESCENCE IN SUPERCONDUCTORS AND THE PROPAGATION CHARACTERISTICS OF HIGH-FREQUENCY PHONONS IN Ge:Sb AND $Al_2O_3:V^{3+}$. Dynes, R. C.; Narayanamurti, V. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., B; 6: No. 1, 143-71(1 Jul 1972).

A detailed account is presented of phonon generation by superconducting tunnel junctions (Sn/I/Sn) and by Sn and $Pb_{0.5}Tl_{0.5}$ films pumped by a heat pulse. The spectrum and propagation characteristics of the generated phonons are studied through the resonance absorption by Sb-donor levels in uniaxially compressed Ge. At all values of generator power (up to a few watts) the emitted phonons show a large density at a value of energy equal to the superconducting energy gap (2Δ). In contrast, the spectrum emitted by a constantan heater is shown to be in quantitative agreement with the blackbody-radiation model. The experiments show that the mean free path of longitudinal and transverse phonons in the superconductor changes discontinuously when $\hbar\omega = 2\Delta$. Theoretical calculations show that significant reabsorption of phonons of energy >2Δ results in a nonlinear buildup of the intensity of the 2Δ phonons. The propagation characteristics of these phonons in Ge:Sb show a frequency and polarization dependence in excellent agreement with the Griffin–Carruthers theory of resonance-fluorescence phonon scattering by donor levels. The magnetic field tunability of the generated 2Δ phonons in Sn is utilized to study the ground state of V^{3+} in Al_2O_3. Transverse phonons of energy 1.02 meV propagating along the c axis are resonantly absorbed as expected according to theory. (auth)

57522 PHONON SPECTRUM OF La. Lou, L. F.; Tomasch, W. J. (Univ. of Notre Dame, Ind.). Phys. Rev. Lett.; 29: No. 13, 858-61(25 Sep 1972).

Observed phonon structure in the tunneling density of states of superconducting La films (T_c = 4.9°K, $2\Delta/kT_c = 3.8$) contains resolvable detail not reported previously, with maximum deviations from the BCS prediction amounting to 1.7%. The McMillan–Rowell method of analysis produces a phonon spectrum $\alpha^2F(\omega)$ characterized by parameters which predict T_c = 5.0°K via the McMillan equation. Implications of this agreement are discussed. (auth)

Equipment and Devices

57523 TEMPERATURE DEPENDENCE OF THE CRITICAL CURRENT OF A DOUBLE JOSEPHSON JUNCTION. Halse, M. R.; Salleh, K. M. (Univ. of Kent, Canterbury, Eng.). J. Phys., C (London): 5: No. 13, 1643-8(10 Jul 1972).

The critical current of a double Josephson junction is expected to increase in an oscillatory manner as the temperature is lowered. The effect arises whenever the critical currents of the two junctions are different and/or when there is geometric asymmetry. (auth)

57524 PHOTOEXCITATION OF QUASIPARTICLES IN NONEQUILIBRIUM SUPERCONDUCTORS. Parker, W. H.; Williams, W. D. (Univ. of California, Irvine). Phys. Rev. Lett.; 29: No. 14, 924-7(2 Oct 1972).

Measurements are reported on superconducting tunnel junctions illuminated with optical radiation, which confirm the model of nonequilibrium superconductors proposed by Owen and Scalapino. Measurements of the chemical potential μ^* for quasiparticle excitations and of the temperature dependence of the quasiparticle recombination time are presented. (auth)

57525 NIOBIUM SUPERCONDUCTIVE TUNNEL DIODE INTEGRATED CIRCUIT ARRAYS. Hoel, L. S.; Keller, W. H.; Nordman, J. E.; Scott, A. C. (Univ. of Wisconsin, Madison). Solid-State Electron.; 15: No. 10, 1167-73(Oct 1972).

A technology is described for building arrays of niobium-based thin film superconductive tunnel junctions. Both Nb/Nb oxide/Sn negative resistance devices and Nb/Nb oxide/Pb Josephson devices were fabricated using a modified photoresist-sputter etching technique to make patterns in the Nb film. Good control over the volt-ampere characteristics of the Josephson junctions is demonstrated on single devices and is further illustrated by the use of this process to fabricate multistate oscillator arrays. (auth)

57526 INFLUENCE OF THE PROPERTIES OF THE MATERIALS ON JUNCTION TUNNELLING CHARACTERISTICS. Burrafato, G.; Faraci, G.; Giaquinta, G.; Mancini, N. A. (Univ., Corso, Italy). J. Phys., C (London); 5: No. 16, 2179-91(21 Aug 1972).

The phonon excitation spectra of Pb and Sn were obtained from an analysis of the electron tunnel characteristics of junctions with the electrodes in the normal and the superconducting state. Metallic junctions with two different types of insulating barrier, Al_2O_3 and Formvar were used. The large resonant peak due to the Formvar long molecular chains was resolved for lead. Self energy effects for the quasi electrons in tin were revealed and interpreted in terms of coulombic contributions since tin is a weakly coupled electron–phonon system. Similar effects for the quasi holes were observed for tin in the presence of Formvar. It is also found that proper vibrations of the insulators and of the metals may be reciprocally transferred. (auth)

57527 FOUR STUDIES IN SUPERCONDUCTIVE QUANTUM INTERFERENCE. Simmonds, Michael Bancroft. Irvine, Calif.; Univ. of California (1971). 168p. University Microfilms Order No. 72-14,668.

Thesis.

Several problems, broadly related to the measurement of the Compton wavelength of the electron, were investigated. First, an analog computer was used to simulate the behavior of a weakly connected superconducting ring inductively coupled to a resonant L–C circuit. The weak link was characterized both by a current-phase relation of the form $I = I_c \sin \varphi$ and by supercurrent breakdown model: the results were compared. The effects of a normal resistance shunting the junction were investigated, as well as the effects of thermal current noise in the ring. Some criteria for achieving optimum coupling to the superconducting ring are discussed. In the second study, the current–voltage characteristics of thin-film superconducting Dayem bridges were measured near their transition temperature. The effects of thermal fluctuations on those characteristics were found to be in excellent agreement with a calculation made by Ambegaokar and Halperin. The third investigation was concerned with the development of an improved thin-film quantum interference junction. The desired characteristics of such junctions are discussed. The relevant properties of various superconducting thin films are then surveyed. Various junction geometries and their operating characteristics are presented. Some special fabrication techniques such as sputter etching and electron beam exposure of polymer resist are discussed. Finally, the techniques and results of an actual measurement of h/m using rotating superconducting rings are presented. The problems of rotating the rings, measuring their cross sectional area, and stabilizing their magnetic environment are discussed in detail. The value of h/m in this measurement was found to be $(7.7768 \pm 0.0028) \times 10^{-4}$ Joule sec kg^{-1}, which represents a precision of 500 ppM. The technical problems associated with making a more precise determination of h/m are discussed as well as the fundamental limitations of this method. Finally, the implications of a precision measurement of h/m on a least-squares adjustment of the fundamental constants are considered. (Diss. Abstr. Int., B)

57528 SPECTROSCOPY WITH PHONONS ON $Al_2O_3{:}V^{3+}$ USING THE PHONON BREMSSTRAHLUNG OF A SUPERCONDUCTING TUNNEL JUNCTION. Kinder, H. (Kernforschungsanlage, Juelich, Ger.). Phys. Rev. Lett.; 28: No. 24, 1564-7(12 Jun 1972).

The sharp edge of the phonon bremsstrahlung spectrum of a superconducting tunnel junction was isolated by modulation. This yielded a monochromatic, voltage-tunable phonon source which was applied for phonon spectroscopy on V^{3+} ions in Al_2O_3. At a frequency corresponding to the ground-state splitting of V^{3+}, an absorption dip was obtained due to resonant scattering. A frequency resolution of about 3% of the energy gap was achieved. (auth)

PHYSICS (NUCLEAR)

57529 (AECL-4205) PHYSICS DIVISION PROGRESS REPORT, JANUARY 1–MARCH 31, 1972. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). May 1972. 77p. (PR-P-93). Dep. NTIS (U. S. Sales Only). AECL $2.00.

Progress is reported by the Physics Division of Atomic Energy of Canada Limited for the period January 1 to March 31, 1972. Summaries of projects in the Nuclear Physics, Neutron and Solid State Physics, Theoretical Physics, and Mathematics and Computation Branches are provided. (E.M.T.) (Canada)

57530 (LYCEN-7201) ANNUAL REPORT, JANUARY 1972. (Lyon Univ. (France). Institut de Physique Nucleaire). 130p. (In French). Dep. NTIS (U. S. Sales Only).

The studies undertaken in 1972 by the Institute of Nuclear Physics of Lyons are presented: nuclear structure and spectrometry, theoretical and experimental studies of nuclear reactions, radiochemistry, research on linear accelerators and experimental techniques. (France)

Neutron Interactions with Matter

Refer also to abstract 56175.

57531 (BNWL-1675) TISK: A PROGRAM FOR CALCULATING THERMAL NEUTRON SCATTERING KERNELS, AND ITS APPLICATION TO H_2O. Gibbs, A. G.; Lindenmeier, C. W. (Battelle Pacific Northwest Labs., Richland, Wash.). Jun 1972. Contract AT(45-1)-1830. 64p. Dep. NTIS.

The TISK Code is designed to operate on the UNIVAC 1108 computer system. The code computes either the thermal neutron scattering law $S(\alpha,\beta)$ or the zeroth and first Legendre moments of the scattering cross section. (L.T.W.)

57532 (KURRI-TR-96) NEUTRON ENERGY CONVERTER OF FISSION PLATE TYPE. Kanda, Keiji; Kobayashi, Keiji; Chatani, Hiroshi; Shibata, Toshikazu (Kyoto Univ. (Japan). Research Reactor Inst.). 1972. 15p. (In Japanese). Dep. NTIS (U. S. Sales Only).

A neutron energy converter of fission plate type of 27 cm in diameter was made with 90% enriched uranium of about 1.1 kg. It serves as a standard neutron source in combination with the KUR heavy water facility. The specifications and the manufacturing procedure are described. The characteristics of the converter were examined from the viewpoints of the incident and yielded neutron fluxes, induced activities, calorific value, etc. (auth)

57533 (NP-19429) TRITIUM NEUTRON SOURCE AND FAST NEUTRON STUDIES. Greenwood-Smith, Robin (Melbourne Univ., Parkville (Australia). School of Physics). Jun 1971. 180p. Dep. NTIS (U. S. Sales Only).

Thesis.

The design and construction of a variable energy $^3H(p,n)$ monoenergetic fast neutron source is described with particular reference to radiation safety criteria. A study of the performance of the source, using the Cyclotron variable energy proton beam, is presented. A measurement of the $^{14}N(n,n)^{14}N$ excitation function, in the region of a $T = ^3\!/_2$ level at 13.41 MeV in ^{14}N, is discussed and theoretical evidence is produced to discount the T assignment. Results of a measurement of the $^{24}Mg(\alpha,n)^{27}Si$ excitation function from threshold (8.41 MeV) to 13.1 MeV are produced and discussed in relation to the fluctuation theories for nuclear cross sections at high excitations. (auth)

57534 TEORETICHESKIE I EKSPERIMENTAL'NYE PROBLEMY NESTATSIONARNOGO PERENOSA NEITRONOV. (Theoretical and Experimental Problems in the Non-Steady-State Movement of Neutrons). Orlova, V. V.; Stumbura, E. A. Moscow; Atomizdat (1972). 352p.

This collection of 20 separate papers by different authors deals with the non-steady state migration of neutrons through moderating and breeding media. Prompt fission neutrons, pulsed sources of neutrons, and methods for measuring neutron-physical parameters and the reactivity in $U-H_2O$ systems are examined in detail. Neutron migration of diffusion through ethanol (–5 to +135°C), and the thermalization process in graphite, beryllium, zirconium hydride, and water are discussed. (K.S.W.)

57535 ANALYSIS OF PULSED NEUTRON EXPERIMENT IN BERYLLIUM BY THE METHOD OF INELASTIC SCATTERING EXPANSION. Matsumoto, Takaaki (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 8, 453-64(Aug 1972).

Pulsed neutron experiments in beryllium have been analyzed by the method of inelastic scattering expansion. Considering the full range of energy, the present method is applied to the calculation of the time dependent spectra within a system as well as at its surface. For obtaining the decay curve of the neutron counting rate, the neutrons are classified according to the number of specified inelastic scatterings that scatter the neutrons over the Bragg cutoff energy. The pseudo mode is, as a principal result, shown to correspond to an eigen solution of the thermal bounded equation. The buckling dependence of the eigenvalue and the eigen spectrum of the thermal bounded equation are studied, and useful approximate expressions are derived. The calculated results are compared with the experiments by Fullwood et al. and other authors. (auth)

57536 NEUTRON SCATTERING. Hastings, Julius M.; Hamilton, Walter C. (Brookhaven National Lab., Upton, N. Y. Associated Universities, Inc., Upton, N. Y.). pp 159-214 of Physical Methods of Chemistry. Pt. IIID. /Weissberger, Arnold (ed.). New York; John Wiley and Sons, Inc. (1972).

Topics discussed include scattering of neutrons, methods of measurement for Bragg scattering, apparatus, structure determination by neutron diffraction, magnetic structures, and neutron spectroscopy. (J.W.R.)

57537 CORRECTION FOR MULTIPLE SCATTERING IN COLD NEUTRON EXPERIMENTS. Tiitta, A.; Tunkelo, E. (State Inst. for Technical Research, Otaniemi, Finland). Nucl. Instrum. Methods; 103: No. 3, 575-80(1972).

The effect of multiple scattering in inelastic cold neutron scattering experiments has been investigated by Monte Carlo simulation using Griffing's theoretical model for gaseous methane. The influence of sample geometry on multiple scattering has been investigated. Calculations have shown that the optimization of sample dimensions and position is not sufficient to reduce multiple scattering to an acceptable level, at least in small scattering angles. Accordingly a new correction method has been developed. The multiply scattered spectrum has been found to resemble the Maxwell spectrum. The correct cross section could be reproduced by subtracting a Maxwell spectrum, corresponding to the multiply scattered intensity, from the total scattered intensity. This method has been found to apply to samples of transmission more than 80% within a maximum error of a few percent. The new method is believed to give the best results with samples in which most of the scattering is due to hydrogen or other light elements. (auth)

57538 EFFECT OF A MAGNETIC FIELD ON NEUTRON DIFFUSION. Kazachenkov, Yu. N.; Orlov, V. V. At. Energ. (USSR); 33: No. 2, 681-5(Aug 1972). (In Russian).

A system of kinetic equations describing neutron transport in a magnetic field was derived. For the case of one-dimensional axial-symmetrical problems, this system is reduced to a system of equations for four scalar functions. These functions were expanded in series in polynomials or associated Legendre polynomials, and a system of ordinary differential equations was written for expansion coefficients. It is shown that spin-orbital interaction no longer affects neutron diffusion at a magnetic flux density of the order of $v\Sigma_{t_2}/\gamma_n$. (tr-auth)

57539 INFLUENCE OF A MAGNETIC FIELD ON NEUTRON DIFFUSION, AND THE POSSIBILITY OF MAGNETIC CONTROL OF REACTORS. Orlov, V. V.; Kazachenkov, Yu. N. At. Energ. (USSR); 33: No. 2, 710-11(Aug 1972). (In Russian).

The existence of spin and a magnetic moment of a neutron suggests the possibility of an influence of a magnetic field on neutron diffusion. Mathematical treatment shows that as a result of spin-orbital interaction, the coefficient of diffusion at some energies might be altered as much as 20%. In the absence of spin-orbital interaction, spin-spin may affect neutron diffusion only in the case of substances with oriented nuclei. These two types of interaction offer a possibility of excitation by a magnetic field of short (~ 1 μsec) pulses in fast reactors. (K.S.W.)

57540 MONTE CARLO SAMPLING WITH CONTINUOUSLY VARYING CROSS SECTIONS ALONG FLIGHT PATHS. Carter, L. L.; Cashwell, E. D.; Taylor, W. M. (Los Alamos Scientific Lab., N. Mex.). Nucl. Sci. Eng.; 48: No. 4, 403-11(Aug 1972).

A scheme is proposed to sample the distance to collision, without resorting to numeric integration, when the total macroscopic cross section varies in an arbitrary manner along projected particle flight paths. This sampling scheme is utilized in some example problems to illustrate methods of optimizing the sampling of the collision point in such a manner as to minimize relative errors for a fixed amount of computation time. (auth)

57541 TWO-GROUP NEUTRON-TRANSPORT THEORY: EXISTENCE AND UNIQUENESS OF THE H-MATRIX. Siewert, C. E.; Burniston, E. E.; Kriese, J. T. (North Carolina State Univ., Raleigh). J. Nucl. Energy; 26: No. 9, 469-82(Sep 1972).

The system of singular-integral equations and linear constraints which define mathematically the H-matrix relevant to a class of two-group neutron transport problems is shown to possess a unique solution. The analysis is based on a matrix version of the Riemann problem appropriate to which a discussion of a class of canonical solutions is given. (auth)

57542 NONHOMOGENEOUS BOUNDARY CONDITIONS IN NEUTRON TRANSPORT. Mika, Janusz; Stankiewicz, Roman (Inst. of Nuclear Research, Swierk, Poland). Transp. Theory Statist. Phys.; 2: No. 1, 55-67(1972).

The rigorous mathematical theory of the time-dependent neutron-transport equation with nonhomogeneous boundary conditions is developed. The existence and uniqueness of the solution in the spaces of summable functions are demonstrated. The theory is applied to the case of an oscillating boundary source appearing in neutron-wave experiments, and the properties of the asymptotic wave solution are found. (auth)

57543 CRITICAL SLAB SOLUTION TO THE TWO-GROUP NEUTRON TRANSPORT EQUATION FOR LINEARLY ANISOTROPIC SCATTERING. Bosler, Gerald Eugene. Charlottesville, Va.; Univ. of Virginia (1972). 271p. University Microfilms Order No. 72-22,649.

Thesis.

The one-dimensional, bare, homogeneous, critical slab problem is solved by the singular eigenfunction approach to the two-group neutron transport equation for linearly anisotropic scattering. A two-group half-range expansion of the eigenfunctions is developed, and the expansion coefficients are numerically determined from coupled singular integral equations. Comparisons of the "exact" results with the P_1, P_3, DP_1, S_4, S_8, and S_{16} approximations reveal that the relatively easy computational method known as DP_1 provides the best estimate on the critical half-thickness. DP_1 also yields excellent agreement for the angular fluxes and the total fluxes. As expected, for H_2O and D_2O reactor systems, the critical half-thicknesses calculated from the linearly anisotropic scattering are significantly larger than the critical half-thicknesses calculated from isotropic scattering. These original "exact" two-group solutions for linearly anisotropic scattering also demonstrate that the transport approximation slightly underestimates the critical half-thickness but very closely approximates the total flux. Because of the laborious computational techniques that are utilized, the "exact" solution has restrictive usage. At present, the "exact" solution may be used as a benchmark for comparisons to determine which approximate method provides the optimum results, i.e., the best solution for the minimum amount of computational effort. However, it is felt that more advanced and judicious computer programming techniques could significantly reduce the computer processing time, and permit the "exact" solution to be even more useful in reactor design. (Diss. Abstr. Int., B)

57544 STUDY OF MULTIPLE NEUTRON SCATTERING IN FINITE SYSTEMS USING FOURIER SERIES EXPANSION. Van Mechelen, C. Ghent; Ghent Rijksuniversiteit (1971). 228p. (In Dutch).

Thesis.

Numerical solution of the Boltzmann equation in finite systems is given. The solution of integral equation of the flux equivalent to the Boltzmann equation is obtained by means of Fourier series. Both anisotropic and isotropic scattering are considered. (Belgium)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 57568 and 57999.

57545 (BNL-17097) RADIATIVE CAPTURE OF PROTONS BY DEUTERIUM. Halbert, M. L. (Oak Ridge National Lab., Tenn.); Paul, P.; Snover, K. A. (State Univ. of New York, Stony Brook); Warburton, E. K. (Brookhaven National Lab., Upton, N. Y.). 1972. 4p. (CONF-720819-10). Dep. NTIS.

From International conference on few particle problems in nuclear interactions; Los Angeles, CA. (28 Aug 1972).

An experimental study of the reaction $p + d \rightarrow {}^3He + \gamma$ between $E_p = 14.0$ and 25.5 MeV gave no indication of a resonance in ^3He in the excitation energy range from 14.9 to 22.5 MeV. (auth)

57546 (COO-7-630) DIFFERENTIAL CROSS SECTIONS FOR SMALL ANGLE SCATTERING OF 24-MeV NEUTRONS BY PROTONS. Masterson, T. G. (Wisconsin Univ., Madison). 1972. 34p. Dep. NTIS.

Absolute n-p elastic scattering cross sections were measured at 19.5° and 25.1° (lab) for an incident neutron energy of 24 MeV. A liquid scintillator detected both the incident and scattered neutrons. The scatterer was a liquid scintillator also. The cm differential cross sections were 31.3 ± 0.5 and 30.7 ± 0.6 mb/sr at cm scattering angles of 39.3° and 50.5°, respectively. The present results agree with the cross sections predicted by Hopkins and Breit. (auth)

57547 (COO-3235-14) NUMERICAL STUDY OF DWBA IN A THREE-BODY MODEL OF STRIPPING. Bouldin, D. P.; Levin, F. S. (Brown Univ., Providence, R. I. Dept. of Physics). 1972. Contract AT(11-1)-3235. 11p. Dep. NTIS.

Exact and DWBA wave functions, stripping amplitudes, and angular distributions were calculated and compared in a separable-potential, three-body model of deuteron stripping. Detailed results are presented and analyzed for the case of deuterons incident with energy E = 6.7 MeV; these are similar to results also obtained for E = 1.78, 11.2, and 15.12 MeV. Despite good agreement between exact and DWBA angular distributions, the two sets of wave functions and partial wave stripping amplitudes themselves do not agree too well. This casts doubts on the validity of the DWBA approximation to the exact wave function, but does support use of the adiabatic wave function of Johnson and Soper in analyses of stripping data. (auth)

57548 (TID-26144) PROTON AND DEUTERON-INDUCED DEUTERON BREAK-UP AT 12.5 MeV. Ibarra, Eduardo Andrade (Rice Univ., Houston, Tex.). May 1972. 146p. Dep. NTIS.

Thesis.

Proton—proton and proton—neutron coincidence spectra from the $p + d \rightarrow p + p + n$ reaction were measured simultaneously for $E_p = 12.5$ MeV and $\theta_1 = -\theta_2 = \theta$ in the interval $15° \leq \theta \leq 60°$. In addition, proton—neutron coincidences with detectors at the same angles were measured in order to study the angular dependence of n-p final state interactions. Deuteron—proton and deuteron—neutron coincidence were also measured for the $d + d \rightarrow d + p + n$ reaction at $E_d = 12.5$ MeV for $\theta_1 = -\theta_2 = \theta$ in the interval $15° \leq \theta \leq 40°$. The measured spectra are discussed in terms of the quasi-free scattering model. The shape of measured spectra and the angular dependence of the peak cross sections are fairly well reproduced by a simple theory. It was found that the ratio of the peak cross section for n-p and p-p quasi-free scattering in the $p + d \rightarrow p + p + n$ reaction varied from 1.3 at $\theta = 15°$ to 4.3 at $\theta = 42.5°$. The ratio of the peak cross section for d-n and d-p quasi-free scattering in the $d + d \rightarrow d + p + n$ reaction was found to be constant and close to one. The variation of σ_{pn}/σ_{pp} peak ratio in the $p + d \rightarrow p + p + n$ reaction can be attributed to the influence of n-p and p-p final state interactions. (auth)

57549 VARIATIONAL CALCULATION OF ELASTIC NUCLEON-DEUTERON SCATTERING. Pieper, S. C. (Case Western Reserve Univ., Cleveland). Nucl. Phys.; A193: No. 2, 519-28(1972).

A previously developed variational principle for three-body scattering is applied to elastic nucleon—deuteron scattering. Separable S-wave potentials are used for both the singlet and triplet channels. The scattering amplitudes obtained agree with previous calculations and are accurate to four places. The three-body wave functions, which are needed for perturbation calculations, are also well converged. (3 figures, 1 table) (auth)

57550 PERTURBATIVE CALCULATION OF SPIN OBSERVABLES IN NUCLEON-DEUTERON ELASTIC SCATTERING. Pieper, S. C. (Case Western Reserve Univ., Cleveland). Nucl. Phys.; A193: No. 2, 529-54(1972).

A two-potential formula based on the Alt, Grassberger, and Sandhas equations for three-body scattering is used in first order to compute elastic nucleon—deuteron scattering amplitudes for separable S-, P-, and D-wave nucleon—nucleon forces. The S-wave part of the interactions is treated exactly by means of a variational technique. Results are presented for the differential cross sections, nucleon and deuteron polarizations, and Wolfenstein parameters at energies of 2 to 77 MeV. The cross sections are in good agreement with the data at all energies, and the nucleon polarizations are in quantitative agreement with experiment at energies under 20 MeV and in qualitative agreement at higher energies. The vector polarizations of the deuteron are qualitatively correct, while the rank-2 tensor polarizations and the Wolfenstein D parameter do not reproduce the available experimental results. The Wolfenstein R and A parameters appear to be in agreement with experiment. A discussion of the significance of the Wolfenstein parameters in N-d scattering is given. (26 figures, 2 tables, 58 references) (auth)

57551 NEUTRON-NEUTRON SCATTERING LENGTH FROM A KINEMATICALLY COMPLETE EXPERIMENT ON THE REAC-

TION $^{2}H(n,p)2n$ AT 14 MeV. Dropmann, E. (Technische Hochschule, Aachen). Nucl. Phys.; A193: No. 2, 610-24(1972).

A two-dimensional neutron time-of-flight spectrum was measured in the reaction $^{2}H(n,p)2n$ with the two neutrons in the final state emerging with lab angles $\vartheta_{n_1} = \vartheta_{n_2} = 8°$ symmetrically with the direction of the 14.1-MeV incident neutrons. A deuterated benzene scintillator was used as the scattering target; this enabled measurement of the energy of the breakup protons. The analysis of the data was done on the basis of differential cross sections calculated with the Born approximation as well as by using the Watson–Migdal model. A χ^2 fit to the experimental data using the Born approximation resulted in a value of -16.8 ± 2.5 fm for the neutron–neutron scattering length α_{nn}. A value $\alpha_{nn} = -13.8 \pm 2.6$ fm was found to give the best agreement with the experimental data for the Watson–Migdal theory. This difference between the resulting α_{nn} values can be understood by the experimental limits of the relative energy E_{nn} of the two neutrons $E_{nn} = 0.18$ to 0.80 MeV. (7 figures) (auth)

57552 FOUR-NUCLEON STUDIES. II. DETERMINATION OF THE $^{2}H(d,\vec{n})^{3}He$ NEUTRON POLARIZATION USING A 16 TO 22 MeV PULSED DEUTERON BEAM FROM THE CYCLOGRAAFF. Hardekopf, R. A. (Duke Univ., Durham, N. C.); Rhea, T. C.; Lisowski, P. W.; Walter, R. L.; Joyce, J. M. (Nucl. Phys.; A191: No. 3, 460-7(4 Sep 1972).

The neutron polarization from the $^{2}H(d,\vec{n})^{3}He$ reaction was measured at 45° c.m. for incident deuteron energies between 16 and 22 MeV. In addition, a polarization angular distribution was measured at 18 MeV. The results show that the 45° c.m. polarization remains above 0.35 in this energy range, but the peak polarization has shifted to near 40° c.m. The usefulness of $^{2}H(d,\vec{n})$ as a source of 10- to 22-MeV polarized neutrons is discussed. (4 figures, 1 table) (auth)

57553 INELASTIC SCATTERING OF ELECTRONS ON PROTON AND ^{6}Li NUCLEUS. Titov, Yu. I.; Stepula, E. V. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 15: No. 4, 649-54 (Apr 1972). (In Russian).

The 1180 MeV electron inelastic scattering cross section at 16 to 55° on ^{6}Li and on a liquid hydrogen target has been measured. The measured cross section and one calculated in momentum approximation were compared. The ratio of Δ_{1236} electroproduction cross section (the integral of the inelastic scattered electrons spectrum) on ^{6}Li to the cross section on a proton is in the limits of 4.8–6.6 for different angles. The differential cross section of quasielastic scattering is less than the sum of the elastic cross-sections on three protons and three neutrons by the value of 20–30%. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 57533, 57553, 57580, 57582, 57588, 57647, and 57742.

57554 (EANDC(E)–150(U)) PROGRESS REPORT ON NUCLEAR DATA RESEARCH IN THE EURATOM COMMUNITY, FOR THE PERIOD JANUARY 1 TO DECEMBER 31, 1971. (European-American Nuclear Data Committee). May 1972. 186p. (In English and French). Dep. NTIS (U. S. Sales Only).

ALUMINUM-27—neutron total cross section at 50 to 1200 keV, (E)
ANTIMONY-121—energy-level scheme from neutron inelastic scattering, (E)
ANTIMONY-123—energy-level scheme from neutron inelastic scattering, (E)
BISMUTH-209—photon resonance scattering at 7.2 MeV, γ spectra from, (E)
—neutron elastic scattering at 2.45 MeV, cross sections and polarization for, (E)
BORON-11—neutron total cross section at 50 to 1200 keV, (E)
CHROMIUM-52—neutron inelastic scattering at 14.2 MeV, γ yields from, (E)
INDIUM-113—neutron capture at resonance energies, resonance spin assignments for, (E)
INDIUM-119—neutron capture at resonance energies, resonance spin assignments for, (E)
IRON-54—neutron reactions (n,p) up to 20 MeV, cross section for, (E)
IRON-56—deuteron reactions (d,n) at 6 MeV, neutron spectra from, (E)
—proton reactions (p,n) at 10 MeV, neutron spectra from, (E)
—neutron inelastic scattering at 14.2 MeV, γ yields from, (E)
LEAD—neutron elastic scattering at 2.45 MeV, cross sections and polarization for, (E)
LEAD-208—photon resonance scattering at 7.2 MeV, γ spectra from, (E)
LITHIUM-6—triton reactions $(t,n)2\alpha$ at 0.5 to 0.9 MeV, α spectra from, (E)
—neutron reactions (n,α) at 20 keV to 1.7 MeV, cross section for, (E)
LITHIUM-7—deuteron reactions (d,n) at 2 to 12 MeV, angular distributions for, (E)
MAGNESIUM-24—neutron inelastic scattering at 14.2 MeV, γ yields from, (E)
NICKEL-58—energy-level scheme from neutron inelastic scattering, (E)
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NICKEL-60—energy-level scheme from neutron inelastic scattering, (E)
PLUTONIUM-239—neutron fission at 50 to 2000 eV, average cross sections for, (E)
PLUTONIUM-240—neutron fission at 1.5 to 15 MeV, prompt neutron yield from, (E)
PLUTONIUM-241—neutron fission up to 100 eV, multilevel analysis of
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SILICON-28—neutron inelastic scattering at 14.2 MeV, γ yields from, (E)
SODIUM-23—neutron inelastic scattering at 14.2 MeV, γ yields from, (E)
SULFUR—neutron total cross section at 50 to 1200 keV, (E)
SULFUR-32—neutron inelastic scattering at 14.2 MeV, γ yields from, (E)
TITANIUM-48—neutron inelastic scattering at 14.2 MeV, γ yields from, (E)
TRITONS—reactions $(t,n)2\alpha$ with lithium-6 at 0.5 to 0.9 MeV, α spectra from, (E)
URANIUM-235—neutron fission up to 150 eV, widths for
—neutron fission at 1.5 to 15 MeV, prompt neutron yield from, (E)
—neutron fission at 0.4 MeV, fission neutron spectra from, (E)
VANADIUM—neutron total cross section at 50 to 1200 keV, (E)
YTTRIUM-89—deuteron reactions (d,n) at 10 MeV, neutron spectra from, (E)
ZIRCONIUM-90—neutron capture at resonance energies, resonance spin assignments for, (E) (J.W.R.)

57555 (FRNC-TH–238) TOTAL p–^{12}C CROSS SECTION BETWEEN 190 AND 560 MeV. Favier, Bernard (Grenoble Univ. (France). Faculte des Sciences). 1971. 43p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Measurements made on the total proton–^{12}C nuclear cross sections between 190 and 560 MeV are presented. These measurements were made using the CERN synchrocyclotron. The various corrections made to the absorption ratio before the extrapolation to 0 degrees are outlined. The accuracy obtained for the total cross section values varies between 1 and 3% according to the energy. It is difficult to improve on this value because of the error occurring in α_N (the ratio of the real and imaginary parts of the nuclear amplitude in the energy range considered). (France)

57556 (LBL–731) TEST OF TIME REVERSAL INVARIANCE IN ^{19}Ne BETA DECAY. Girvin, Donald Claude (California Univ., Berkeley. Lawrence Berkeley Lab.). 30 Mar 1972. Contract W-7405-eng-48. 100p. Dep. NTIS.

Thesis.

A new experimental upper limit on the "time-reversal" coefficient D is reported for the allowed beta decay $^{19}Ne \rightarrow F^{19}e^{+}\nu_{e}$. The result is given in terms of the relative phase angle between the vector (V) and axial-vector (A) couplings, $\phi_{A,V}(^{19}Ne) = 180.1 \pm 0.3°$. The V and A couplings are relatively real, implying that T invariance holds in the V-A Theory at zero momentum transfer. The present result does not exclude the possibility of a T violation in the momentum-transfer-dependent weak couplings of the $\Delta S = 0$ hadronic weak current. The experiment was performed with an atomic beam apparatus in which either of the $m_I = +\frac{1}{2}$ or $m_I = -\frac{1}{2}$ magnetic substates was selected from a beam of $^{1}S_0$ ground state ^{19}Ne atoms. The polarized beam terminated its flight in a cell (bulb) where the ^{19}Ne atoms remained for approximately 4 seconds without substantial spin relaxation. The measurement of those delayed coincidences between positrons and the $^{19}F^{-}$ recoil ions whose momenta are, on the average, perpendicular to the nuclear spin $\vec{I}$ of ^{19}Ne served to measure the "D" coefficient. The nuclear polarization of the ^{19}Ne contained in the cell was monitored continuously by observation of the positrons emitted parallel and antiparallel to the spin axes. (auth)

57557 (ORNL-RSIC-34(Vol.1)) DEFENSE NUCLEAR AGENCY WORKING CROSS SECTION LIBRARY: DESCRIPTION AND CONTENTS. Roussin, Robert W. (Oak Ridge National Lab., Tenn.). Oct 1972. Contract W-7405-eng-26. 110p. Dep. NTIS.

The working cross section library maintained for the Defense Nuclear Agency at the Radiation Shielding Information Center is described. The data format for the library is briefly discussed. A short history of modifications to the library is given. Listings of FILE 1 of the library tapes are presented. (J.W.R.)

57558 (ORNL-TM-3868(Rev.)) SDT2. OXYGEN BROOMSTICK EXPERIMENT: AN EXPERIMENTAL CHECK OF NEUTRON TOTAL CROSS SECTIONS. Maerker, R. E. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 17p. (ENDF-167(Rev.)). Dep. NTIS.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. (auth)

57559 (ORNL-TM-3869(Rev.)) SDT3. NITROGEN BROOMSTICK EXPERIMENT: AN EXPERIMENTAL CHECK OF NEUTRON TOTAL CROSS SECTIONS. Maerker, R. E. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 17p. (ENDF-168(Rev.)). Dep. NTIS.

The experimental and calculational details for a CSEWG integral data testing shielding experiment on nitrogen are presented. (auth)

57560 (ORNL-TM-3932) TIME-DEPENDENT NEUTRON AND SECONDARY GAMMA-RAY TRANSPORT IN INFINITE HOMOGENEOUS AIR: COMPARISON OF TWO CROSS-SECTION SETS. Engle, W. W. Jr.; Mynatt, F. R. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 100p. Dep. NTIS.

Time-dependent ANISN calculations were performed for the transport of neutrons and secondary gamma rays in infinite homogeneous air for the purpose of determining the effects of using the most recent ENDF/B-III data from Young and Foster compared with the much used multigroup cross-section set prepared by Straker. A hybrid set containing the neutron cross sections from ENDF-III and the gamma-ray production from the Straker set were also used. The calculation extended to a range of 3000 meters and 10 sec elapsed time. Both a 14-MeV and a "typical" thermonuclear source were used and results for several response functions were calculated and are presented graphically in both time-dependent and time-independent modes. (auth)

57561 (ORNL-TM-3957) SDT6: EXPERIMENT ON SECONDARY GAMMA-RAY PRODUCTION CROSS SECTIONS ARISING FROM THERMAL-NEUTRON CAPTURE IN IRON, STAINLESS STEEL, NITROGEN, AND SODIUM. Maerker, R. E. (Oak Ridge National Lab., Tenn.). Oct 1972. Contract W-7405-eng-26. 14p. (ENDF-176). Dep. NTIS.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. This particular experiment measured the secondary gamma-ray production cross sections arising from thermal-neutron capture for iron, a type 321 stainless steel, nitrogen, and sodium. Gamma-ray cross sections were binned into ~0.5-MeV wide energy intervals. (auth)

57562 (UCSB-34-P-144-8) NUCLEAR STRUCTURE RESEARCH. Progress Report. Eisberg, Robert M. (California Univ., Santa Barbara). Sep 1971. Contract AT(04-3)-34. 21p. Dep. NTIS.

Measurements of the angular correlation of the ground state $^{16}O(p,2p)^{15}N$ reaction at 45-MeV have been completed. The equipment perfected in making these measurements will be used in the coming year to study (p,2p) reactions on ^4He and also to study p-^4He bremsstrahlung processes. Also described are measurements of inelastic proton scattering at very small angles, using a recently developed technique for eliminating the adverse effects of nuclear reactions on the response of solid state detectors. Additional measurements of this type will be made in the coming year. The extension of the new detector technique to the intermediate energy range, with the idea of using it at LAMPF has been studied. In this connection the group has participated in developing and testing very promising detectors using intrinsic semi-conductor Ge. These developments are described and will be continued, and emphasized, in the immediate future. One member of the group has participated in a large angle d-p elastic scattering measurement at several hundred MeV. (auth)

57563 STUDY OF REACTION (e,e′α). Abe, K. (Tohoku Univ., Sendai); Tsubota, Hiroaki; Kawamura, Nobuaki; Kanazawa, Masaaki. Kakuriken Kenkyu Hokoku; 4: No. 1, 42-7(Sep 1971). (In Japanese).

The Be(γ,α) reaction was successfully studied with a dE/dX−E telescope. Surface barrier type silicon detectors were used for the telescope. A special pre-amplifier was designed and installed with the telescope and a target in a scattering chamber. A fast linear gate circuit based on new principle was also designed. Signals of ΔE and E were fed to a two-parameter analyzer. Two-parameter spectra of ^{241}Am−α, ^{228}Ra−α and Be(γ,α) were shown. It was hard to obtain correct energy spectra from the observed ΔE−E distribution, because of Landau fluctuations in dE/dX detectors, energy dependence of dE/dX, and nonlinearity of circuit system. Considering the large effect of the Landau fluctuation, the spectra were resolved and shown. The spectrum of ^{228}Ra−α was in agreement with pulse height spectrum of single parameter analysis. The spectrum of Be(γ,α) showed a dip due to smallness of the coincidence signals. It is, however, hard to draw conclusions from the present data because of various decay modes of Be. (Japan)

57564 NEUTRON ENERGY SPECTRUM FROM ABSORPTION OF NEGATIVE MUONS BY O, S, Ca, AND Pb Nuclei. Voitkovska, I.; Evseev, V. S.; Kozlovski, T.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 6, 1154-64(Jun 1972). (In Russian).

The neutron energy spectra have been measured in nuclear μ^--capture in O, S, Ca and Pb for the energy range 2 to 13 MeV. In the spectra for O, S and Ca some peculiarities such as separate lines and wide bands have been observed. This fact confirms a hypothesis on a dominating role of transitions for nuclear μ^--capture with excitation of quasibounded states of intermediate nuclei, which are isotopic analogs of giant dipole resonances of the target. (auth)

57565 INVESTIGATION OF PARTICLES AT 90° IN L-SYSTEM IN NUCLEUS–NUCLEUS INTERACTIONS. Marutyan, N. A. (Inst. of Physics, Erevan). Yadern. Fiz.; 15: No. 6, 1181-3 (Jun 1972). (In Russian).

The characteristics of 25 secondaries, entering the backward hemisphere in the L-system, have been studied in eleven selected events for energy range $10^{10} - 3.10^{11}$ eV/nucleon in nucleus–nucleus interactions. The emission frequency, the value of the transverse momentum, and the angular distribution are presented. (auth)

57566 ^{6}Be AND ^{9}B NUCLEUS LEVELS FROM (p,n)-REACTIONS. Arifkhanov, U. R.; Gulyamov, M.; Islamov, B. I.; Ergashov, E. (Inst. of Nuclear Physics, Tashkent). Yadern. Fiz.; 15: No. 6, 1102-3(Jun 1972). (In Russian).

The reactions $^6Li(p,n)^6Be$ and $^9Be(p,n)^9B$ at $E_p = 17.8$ MeV were investigated with a spectrometer by the time-of-flight method. The width of a ^{6}Be (1.67) excited state $\Gamma = 0.85 \pm 0.20$ MeV was estimated from the first reaction neutron spectrum. The secondary reaction neutron spectrum at some angles clearly shows a peak which corresponds to a ^{9}B state with $E^* = 3.09 \pm 0.10$ MeV being determined in this work. (auth)

57567 ELECTRON SCATTERING FROM ^{19}F. Oyamada, Masayuki (Tohoku Univ., Sendai); Terasawa, Tatsuo; Nakahara, Kazuo; Endou, Yorimasa; Saito, Hajime. Kakuriken Kenkyu Hokoku; 4: No. 1, 25-9(Sep 1971). (In Japanese).

Energy spectra of scattered electrons from ^{19}F were measured to investigate the nuclear structure of ^{19}F. Incident energies of electrons were 150 and 250 MeV. Odd-parity states of ^{19}F at 1.35, 4.00, 4.04, 5.42 and 5.63 MeV were strongly excited. Spins and parities of the observed levels were estimated from the q (momentum transfer)-dependence of form factors. Electric octupole character was seen in the q-dependence of form factors at the 1.35, 4.00, 5.42 and 5.63 MeV levels, and E5 character in the q-dependence of the 4.04 MeV level. These form factors were compared with those at the corresponding levels of ^{16}O. The comparison was performed for reduced matrix elements. All the reduced matrix elements of ^{19}F were smaller than the corresponding elements of ^{16}O. Electromagnetic transition probabilities from the levels mentioned above were estimated and shown in a table. (Japan)

57568 SEARCH FOR BROAD RESONANCES IN ^{3}He. Bunker, S. N.; Jain, Mahavir; Miller, C. A.; (and others) (Univ. of Manitoba, Winnipeg). Can. J. Phys.; 50: No. 12, 1295-9(15 Jun 1972).

Recently experimental evidence has been presented for the existence of broad T = ½ resonances in the three-nucleon system. As a continuation of earlier studies the ^{6}Li(p,α) reactions were investigated using 45.0 MeV incident protons. ^{3}He and alpha-particle spectra were measured at extreme forward angles using a ΔE−E−VETO detector telescope in conjunction with an analog particle identifier. Excitation energies up to 30 MeV in ^{3}He could be examined. The spectra do not show any structure that can be related to the resonances observed previously. However, the spectra exhibit evidence for quasi-free scattering of protons from the α cluster in ^{6}Li. In a complementary study the ^{3}He(p,2p) reactions were investigated at an incident energy of

45.0 MeV. Data were taken with coplanar, symmetric geometry at 10 pairs of angles between 25° and 60° and also with coplanar, asymmetric geometry at the following pairs of angles: $\theta_1 = 40°$; $\theta_2 = 30°$, 37.4°, 40°, 45°, 50°, 55°, 60°, and 70°. Pronounced kinematic bands due to the ^{3}He(p,2p)d and ^{3}He(p,2p)d* reactions were observed. A comparison of the continua of coincident proton–proton events with the predictions of four-body phase-space calculations shows good agreement. The four-body continua do not show any anomalies which can be interpreted as due to broad resonances in ^{3}He. (auth) (Canada)

57569 OPTICAL-MODEL CALCULATIONS WITH A REALISTIC NUCLEON–NUCLEON INTERACTION. II. ELASTIC SCATTERING OF PROTONS BY OXYGEN ISOTOPES. Lerner, Gerald M.; Marion, Jerry B. (Univ. of Maryland, College Park). Nucl. Phys.; A193: No. 2, 593-609(1972).

Angular distributions for the elastic scattering of protons by ^{16}O, ^{17}O, and ^{18}O were measured at a bombarding energy of 65 MeV. The ^{16}O data were fitted with a standard optical-model search as well as with a generalized optical-model potential derived from three-body theory which uses a fully off-shell T matrix as the effective interaction. The ^{17}O and ^{18}O data were fitted by using the calculated ^{16}O potential plus the contribution from the valence nucleon(s). High-quality fits to the data were achieved for all three oxygen isotopes. (9 figures, 7 tables) (auth)

57570 OPTICAL-MODEL CALCULATIONS WITH A REALISTIC NUCLEON–NUCLEON INTERACTION. I. THEORY. Lerner, Gerald M.; Redish, Edward F. (Univ. of Maryland, College Park). Nucl. Phys.; A193: No. 2, 565-92(1972).

The real parts of the optical potentials for the elastic scattering of 65-MeV protons by ^{16}O, ^{17}O, and ^{18}O are calculated in an impulse approximation. The prescription used is derived from three-body theory by considering the system as consisting of the incident nucleon, an active bound nucleon, and an inert core. The effective interaction resulting is a fully off-shell T matrix and is both nonlocal and energy dependent. Reid's soft-core potential is used to generate the requisite T matrices. Antisymmetry between the incident and active nucleon is included, and all relative two-nucleon partial waves with $l \leqq 3$ are retained. The optical potential is constructed by assuming a pure shell-model target and summing the state of the active nucleon through the single-particle states. The resulting nonlocality is investigated explicitly, and is found to be negligible. A coordinate space potential is constructed. When compared to the real parts of phenomenologically generated optical potentials, the potentials are found to be similar in the surface ($r \approx 2$=5 fm) but deeper in the interior. When the parameter-free real well is combined with phenomenological imaginary and spin–orbit wells, high-quality fits to the experimental data are obtained, comparable to those obtained when all three wells are chosen phenomenologically. Off-energy shell effects and the energy dependence are investigated. (11 figures, 5 tables) (auth)

57571 ISOSPIN MIXING IN ^{14}N. Renan, M. J.; Sellschop, J. P. F.; Keddy, R. J.; Mingay, D. W. (Univ. of The Witwatersrand, Johannesburgh). Nucl. Phys.; A193: No. 2, 470-8(1972).

The ^{13}C(p,γ)^{14}N reaction was used to study the γ decay of the 1^- levels at 8.06 and 5.69 MeV in ^{14}N. Branching ratios of all the observed levels populated at the E_p = 550 keV resonance and the lifetime of the 2.31-MeV level were measured. Upper limits were set on the lifetimes of the levels at 5.69 and 8.06 MeV with the Doppler-shift attenuation method. The isospin mixing coefficient of the two 1^- states was obtained from the derived transition strengths, and the lifetime of the 5.69-MeV level was estimated by an indirect method. The deduced E1 and M1 widths were compared with various shell-model predictions. (2 figures, 4 tables) (auth)

57572 ^{10}B(^{3}He,particle) CROSS SECTIONS AND THE 26, 28 AND 32 MeV STATES OF ^{13}N. Bell, R. A. I.; Graham, I. G.; Thompson, J. V.; Titterton, E. W. (The Australian National Univ., Canberra). Nucl. Phys.; A193: No. 2, 385-400(1972).

Absolute differential cross sections were measured for various ^{10}B(^{3}He, particle) reactions at incident energies from 11 to 19 MeV as follows: p_0, p_1 at 90°, 150°; d_0, d_1, d_2, d_3, $d_{4,5}$ at 150°; α_0, α_1 at 30°, 60°, 90°, 150°. At 150° both the $d_{4,5}$ and α_1 groups showed strong increases in yield near 13.5 MeV, indicative of a 32-MeV resonance in the ^{13}N compound system. The nature of states seen at 26, 28, and 32 MeV excitation in these and other reactions is discussed. (9 figures, 1 table) (auth)

57573 PROTON NUCLEAR REACTION CROSS SECTIONS IN CARBON AND THE ^{12}C(p,p$'$3α) REACTION MECHANISM AT 13 MeV. MacLeod, A. M.; Milne, G. R. (Univ. of Glasgow). J. Phys., A (London); 5: No. 8, 1252-61(Aug 1972).

The mechanism of the ^{12}C(p,p$'$3α) reaction at 13 MeV is found to involve the ground state of ^{8}Be and the ground state of ^{9}B in 24% of the events, and the ^{8}Be ground state alone in 51% of the events. The remaining 25% of the events show no clear evidence of levels in intermediate nuclei. The cross section for this reaction is 154 mb. (auth)

57574 MEASUREMENT OF THE MEAN LIVES OF CERTAIN EXCITED ^{19}F LEVELS. Lebrun, Claude (Univ., Nantes, France); Guilbault, Francois; Rosier, Louis-Hubert; Avignon, Paul; Deschamps, Yvon. Compt. Rend., Ser. B; 274: No. 22, 1245-8(29 May 1972). (In French).

The mean-lives of the following excited levels of ^{19}F were measured: 1554.3, 2781.0, and 4551.0 keV. The method employed utilizes the Doppler shift in the energies of the de-excitation photons observed at various angles relative to the recoil of the emitting nuclei. The excited nuclei were produced by the ^{18}O(d,n)^{19}F reaction with a deuteron energy of 4 MeV. (France)

57575 INVESTIGATION OF (γ,t) REACTIONS ON NUCLEI AT BREMSSTRAHLUNG ENERGY UP TO 1200 MeV. Antuf'ev, Yu. P.; Agranovich, V. L.; Ganenko, V. B.; (and others) (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 15: No. 4, 643-8 (Apr 1972). (In Russian).

For the first time a nuclear photodisintegration with triton production at $E_\gamma > 300$ MeV was investigated. Triton spectra and angular distributions from ^{7}Li, ^{9}Be, ^{12}C as well as the relative deuteron and tritium production rates as functions of secondary particle energy, momentum and target nucleus mass were obtained. On the basis of the analysis the conclusion on the great role of secondary processes in the tritium photoproduction is drawn. The catch up and cascade mechanisms may be such processes. (auth)

57576 ELASTIC SCATTERING OF 26.6 MeV α-PARTICLES ON LIGHT NUCLEI. Kuznetsov, B. I.; Ovsyannikova, R. E.; Chernov, I. P. (Tomsk Polytechnical Inst., USSR). Yadern. Fiz.; 15: No. 4, 673-5(Apr 1972). (In Russian).

The differential cross sections for the elastic scattering of 26.6 MeV α-particles on ^{12}C, ^{13}C, ^{14}N and ^{16}O have been measured. A number of peculiarities in the angular distribution behavior for the large scattering angle region have been observed. The backward scattering cross sections on the ^{12}C and ^{16}O nuclei which have an explicit α-cluster structure are considerably larger than on the ^{13}C and ^{14}N nuclei. (auth)

57577 BACKWARD SCATTERING OF DEUTERONS ON LIGHT NUCLEI. Matusevich, V. A.; Solov'ev, V. A.; Chernov, I. P. (Tomsk Polytechnical Inst., USSR). Yadern. Fiz.; 15: No. 4, 670-72(Apr 1972). (In Russian).

Results of a measuring of a large angle elastic deuteron cross sections ^{9}Be, ^{12}C, ^{16}O are given. At large angles a considerable variation of the angular distribution forms is observed when going from one nucleus to another. The experimental results were analyzed using the optical model including a spin–orbital interaction. A satisfactory consistency of the theory and experiment was obtained. (auth)

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Refer also to abstracts 55739, 57533, 57557, 57561, 57564, 57610, 57636, 57646, and 57759.

57578 (COO-2186-7) NUCLEAR SPECTROSCOPY AND NUCLEAR REACTION WORK WITH (A) THE HEAVY ION ACCELERATOR, YALE UNIVERSITY AND (B) THE 4-MeV DYNAMITRON AT SUNY, ALBANY, NEW YORK. Technical Progress Report, December 1, 1971–July 31, 1972. Bakhru, H. (State Univ. of New York, Albany). 1972. Contract AT(11-1)-2186. 16p. Dep. NTIS.

The 1971–72 contract year showed several significant results in terms of the short-lived radioactive and in-beam spectroscopic studies being conducted at the Heavy Ion Accelerator at Yale. A list of publications is given in the appendix. The studies on compound nuclear reaction thresholds for a number of targets of differing shape and shape polarizability were conducted and the program will continue in the coming year. The program at SUNY/Albany using 4 MeV Dynamitron has been aimed to study the alpha particle capture reactions. Studies on ^{26}Mg and ^{29}Si enriched targets have been performed. (auth)

57579 (ORNL-TM-3870(Rev.)) SDT4. SODIUM BROOMSTICK EXPERIMENT: AN EXPERIMENTAL CHECK OF NEUTRON TOTAL CROSS SECTIONS. Maerker, R. E. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 17p. (ENDF-169(Rev.)). Dep. NTIS.

The experimental and calculational details for a CSEWG integral data testing shielding experiment on sodium are presented. (auth)

57580 SPIN ASSIGNMENTS TO HIGHLY EXCITED STATES IN ^{24}Mg FROM TRIPLE-CORRELATION MEASUREMENTS. Zurmuehle, R. W.; Balamuth, D. P.; Fifield, L. K.; Noe, J. W. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett.; 29: No. 12, 795-8(18 Sep 1972).

Triple correlation measurements using the reaction ^{16}O (^{12}C,α_1)^{24}Mg* → α_2 + ^{20}Ne(2$^+$) → γ + ^{20}Ne(g.s.) were made to determine spins and parities of several highly excited states in ^{24}Mg. The results allow unambiguous assignments of spin and parity 8^+ to the states at 16.30 and 16.84 MeV. The group at 16.55 MeV is a doublet with one member having spin and parity 8^+, while the other member is most likely a 9^- state. (auth)

57581 ANALYZING POWER IN Si($\vec{p}$,p) BELOW 15 MeV. Hardekopf, R. A.; Armstrong, D. D.; Keaton, P. W. Jr. (Los Alamos Scientific Lab., N. Mex.). Nucl. Instrum. Methods; 103: No. 2, 425-7(1972).

Analyzing powers, Ay, were measured for protons elastically scattered from a natural silicon target from 5 to 15 MeV. The results indicate that silicon has only limited usefulness as a polarimeter for protons in this energy range. (3 figures) (auth)

57582 BAND STRUCTURE IN ^{21}Ne. Pilt, A. A. (McMaster Univ., Hamilton, Ont.); Spear, R. H.; Elliott, R. V.; (and others). Can. J. Phys.; 50: No. 12, 1286-94(15 Jun 1972).

The ^{18}O(α,nγ) reaction at α-particle bombarding energies of 5.2 and 6.1 MeV was used to study the levels in ^{21}Ne below 4 MeV excitation. A combination of γ-ray angular distribution and linear polarization measurements using a single crystal Ge(Li) polarimeter confirmed the spins and parities of the 1747 and 2867 keV states to be $7/2^+$ and $9/2^+$ respectively and assigned negative parity to the J = $3/2$ level at 3663 keV and J = $5/2$ level at 3886 keV. The state at 3735 keV was shown to have $J^\pi = 5/2^+$. Values of the multipole mixing ratios of γ rays deexciting these states were found to be consistent with previous measurements. A γ–γ coincidence experiment revealed the existence of a (1.8 ± 0.7)% decay branch of the 3886 keV level to the 2790 keV level. The results are interpreted in terms of the Nilsson model. Evidence for the existence of a $K^\pi = 1/2^-$ band based on a hole in the $1p_{1/2}$ shell is given. (auth) (Canada)

57583 STUDY ON ATOMIC NUCLEI BY INELASTIC SCATTERING OF ELECTRONS. Torizuka, Yoshiharu; Kimura, Motoharu; Kojima, Yuzo; Saito, Teijiro; Itoh, Kohei (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 4: No. 1, 1-24(Sep 1971). (In Japanese and English).

The electron beam from the Tohoku 300 MeV linac was employed for studying atomic nuclei. High-resolution measurements of electron scattering from ^{20}Ne, ^{24}Mg, and ^{28}Si were carried out to investigate nuclear deformation. Absolute cross sections were obtained, and nuclear multipole moments related to reduced transition probabilities were extracted from the cross sections. An analysis based on the Nilsson model gave size-independent shape parameters $\beta2$ and $\beta4$. An electron scattering experiment on ^{40}Ca was also performed to study the giant resonance. The spectra of scattered electrons were measured and analyzed. Transverse and longitudinal wave excitation components of nuclei excitation were obtained. Form factors for 19 MeV and 16.8 MeV levels were shown. Analysis of electron scattering experiments of ^{116}Sn and ^{120}Sn shows that the charge distribution of ground states is expressed by an $A^{1/3}$ law and a radial node of transition charge density is required to explain the experiment. It was also found from analysis of low excitation levels of ^{208}Pb that the Tassie model is unable to explain the experiment. (Japan)

57584 DELAYED COINCIDENCE MEASUREMENT OF THE PICOSECONDS LIFETIME OF THE 9.699 MeV (5^-) LEVEL OF ^{28}Si. Barton, R. D.; Wadden, J. S.; Carter, A. L.; Pai, H. L. (Carleton Univ., Ottawa). Can. J. Phys.; 50: No. 12, 1282-5 (15 Jun 1972).

Measurement of the lifetime of the 9.699 MeV (5^-) level of ^{28}Si by an improved self-comparison delayed coincidence method gave a value of (8 ± 4) ps. This is consistent with a Doppler shift attenuation method measurement which gives (3.3 ± 0.8) ps, where the quoted error contains no allowance for uncertainties in F(τ). This consistency gives support to the extension of delayed coincidence measurements into the picoseconds range. (auth) (Canada)

57585 SPECTRA OF γ-RAYS PRODUCED IN ^{30}Si AND ^{34}S CAPTURE OF THERMAL NEUTRONS. Dzhafar, Dzh. D.; Abdulla, A. A.; Al'-Kuraishchi, N. Kh.; (and others) (Inst. of Nuclear Research, Baghdad). Yadern. Fiz.; 15: No. 6, 1093-8(Jun 1972). (In Russian).

Gamma-rays from thermal neutron reactions ^{30}Si(n,γ)^{31}Si and ^{34}S(n,γ)^{35}S were measured with Ge(Li)-spectrometer. Gamma-lines displayed are placed in gamma-transition schemes of ^{31}Si and ^{35}S nuclei. For the bound energy of a last neutron the values 6588.4 ± 0.3 and 6986.3 ± 0.3 keV were obtained respectively for the ^{31}Si and ^{35}S nuclei. (auth)

57586 ANALYSIS OF PROTON ANGULAR DISTRIBUTIONS IN (α,p) REACTION WITH NUCLEI ^{28}Si, ^{31}P, ^{35}Cl, ^{56}Fe, ^{63}Cu, AND ^{65}Cu IN THREE-NUCLEON STRIPPING THEORY. Stryuk, Yu. S.; Tokarevskii, V. V. (Inst. of Nuclear Research, Kiev). Yadern. Fiz.; 15: No. 6, 1109-16(Jun 1972). (In Russian).

Differential cross sections for the (α,p) reactions at α-particle energy 27.2 MeV have been measured. The intense excitation of the final nucleus one-phonon states was observed. The experimental results were analyzed according to the El-Nadi three nucleon stripping theory. To describe the experimental data satisfactorily the form factor exp $(-k^2/12\gamma_\alpha^2)$ was used instead of the form factor exp $(-k^2/6\gamma_\alpha^2)$. The form factor modification is discussed. (auth)

57587 REACTION OF A COMPOUND NUCLEI PRODUCTION WITH ACCELERATED XENON IONS. Flerov, G. N.; Karamyan, S. A.; Popeko, G. S.; Popeko, A. G.; Shelaev, I. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 6, 1117-20(Jun 1972). (In Russian).

A nuclear reaction with accelerated Xenon ions ^{24}Mg(^{132}Xe, 3–5n)$^{153-151}$Dy was observed. The products of the reaction of compound nucleus production were identified from the energy of γ-transfer and fission semidecay periods. (auth)

57588 OBSERVATION OF THE SECOND T = 2 STATE OF ^{20}Ne AS A COMPOUND RESONANCE IN THE ^{19}F + p REACTIONS. Kuan, H. M.; Latshaw, G. L.; O'Connell, W. J.; (and others). (Stanford Univ., Calif.). Nucl. Phys.; A193: No. 2, 497-509 (1972).

The second T = 2 state of the self-conjugate nucleus ^{20}Ne was observed as a compound resonance in the isospin-forbidden reactions ^{19}F(p,p), (p,n), (p,α), and (p,γ) at $E_p = 5.879 \pm 0.005$ MeV. The resonance width Γ_{lab} is 10 ± 3 keV. The excitation energy in ^{20}Ne was 18.427 ± 0.005 MeV, in agreement with the value 18.5 ± 0.1 MeV reported by Cerny, et al. The state was found to decay through the p_0, p_1, p_2, p_3, p_4, p_5, p_7, n_0, $n_1 + n_2$, α_0, α_1, α_2, α_4, and α_8 channels, but not through the α_3, α_5, α_6, α_7 and α_9 channels within the limits of observation. The γ transitions from the state were mainly through the cascade [E_x = 18.427; $J^\pi = 2^+$; T = 2] → [12.25; $(2)^+$; 1] → [1.63; 2^+; 0] with no observed strength in the transitions γ_0 through γ_5. Thus, within the present limits of observation no isospin-forbidden $\Delta T = 2\gamma$ transition was observed. (8 figures, 3 tables) (auth)

57589 INVESTIGATION OF α-PARTICLE SCATTERING FROM ^{24}Mg AS A TEST OF HAUSER–FESHBACH CALCULATIONS IN THE CONTINUUM REGION. Eberhard, K. A ; Trombik, W. (Univ., Munich). Nucl. Phys.; A193: No. 2, 489-96(1972).

The elastic and inelastic scattering of α particles by ^{24}Mg was investigated at bombarding energies between 15.4 and 19.1 MeV. Particular attention was given to the analysis of the inelastic scattering to the 3^+ unnatural-parity state at 5.22 MeV. Both energy-averaged angular distributions and fine-energy-resolution excitation functions were used in the analysis. It was found that the inelastic scattering to the (3^+, 5.22-MeV) state may be interpreted as pure compound nucleus scattering. It is found that the incoherent addition of a compound nucleus cross section and a direct cross section, as has been done in recent analyses, is a realistic way to describe energy-averaged scattering data which contain both direct and compound contributions. (3 figures) (auth)

57590 OPTICAL-MODEL ANALYSIS OF THE ELASTIC SCATTERING OF 100 MeV PROTONS FROM ^{24}Mg AND ^{28}Si. Horowitz, Y. S. (Univ. of The Negev, Beer-Sheva, Israel. McGill Univ., Montreal). Nucl. Phys.; A193: No. 2, 438-48(1972).

Elastic scattering differential cross sections for the interaction of 100-MeV protons with ^{24}Mg and ^{28}Si were measured using a high-resolution Ge(Li) spectrometer to resolve the inelastic scattering contribution to the elastic peak. The results were analyzed using the conventional optical model, and the experimental differential cross sections and total reaction cross section are excellently reproduced. The results agree with previous analyses of the elastic scattering of 100-MeV protons on 1p shell nuclei in that no set of geometric parameters can provide a quantitative fit to both nuclei. It is observed, however, that the fluctuations of the optical-model parameters for optimum fits are decreased over the fluctuations observed for the 1p shell nuclei. The present results combined with previous optical-model analyses on ^{24}Mg and ^{28}Si at 50 MeV and 40 MeV, respectively, are found to be consistent with an energy dependence of $dV/dE \approx -0.3$ for the depth of the real central potential, in agreement with other, more extensive, investigations of the energy dependence for protons elastically scattered by ^{16}O and ^{40}Ca. (2 figures, 2 tables) (auth)

57591 PROTON AND DEUTERON INDUCED REACTIONS ON ^{21}Ne. Heikkinen, D. W.; Lutz, H. F.; Bartolini, W. (Univ. of California, Livermore). Nucl. Phys.; A193: No. 2, 372-84(1972).

The ^{21}Ne(d,d)^{21}Ne, ^{21}Ne(d,p)^{22}Ne, ^{21}Ne(p,p)^{21}Ne, and ^{21}Ne(p,d)^{20}Ne reactions were studied using deuterons of 12.2 and 14.5 MeV and protons of 14.1 MeV with an enriched ^{21}Ne gas target. The results were analyzed with DWBA and coupled-channels calculations. The transfer reaction results are compared with previous work and with both the Nilsson-model and shell-model results. In general, reasonable agreement is found. The inelastic studies were used to deduce deformation parameters. These studies indicate the need for a hexadecapole deformation in order to obtain agreement between the experimental and calculated cross sections. (7 figures, 3 tables) (auth)

57592 INDIRECT DETERMINATION OF THE PHOTONUCLEAR CROSS SECTION ABOVE 20 GeV. Wolfendale, A. W. (Durham Univ., Eng.); Young, E. C. M.; Davis, R. Nature (London) Phys. Sci.; 238: No. 87, 130-1(28 Aug 1972).

Accelerator experiments have measured photonuclear cross sections up to about 17 GeV and have shown that its value is nearly constant at $\sigma\gamma \sim 120$ μb/nucleon in the energy range $5 < E\gamma < 17$ GeV. At higher energies less direct methods must be used, one of which is to study the "nuclear" interactions of fast muons that take place through the virtual photon field accompanying the muon. The problem is thus to measure the interaction cross section of the muon and then determine $\sigma\gamma$. In the studies described data were used that were determined in an experiment designed to search for solar neutrinos and which involved underground exposure of quantities of C_2Cl_4 and a search for ^{37}Ar nuclei produced in the reaction ^{37}Cl(V_e ,e^-)^{37}Ar. It is the contribution to the background signal from the reaction ^{37}Cl(p,n)^{37}Ar, the protons having come from fast muon interactions, that is of interest in the present connection. In the analyses made it was assumed that the only variable parameter associated with the muon is the magnitude of the cross section $\sigma_\gamma(E_\gamma)$ of the virtual photons, and an estimate of this quantity for mean values of $E\gamma$ corresponding to the muons at various depths underground was required. The problem of predicting the variation with depth of the background due to fast muon interactions is considered, and the contribution from cosmic ray neutrino interactions is also considered. From the results obtained there was no suggestion of a marked change in $\sigma\gamma$, at least up to 100 GeV. There was also no firm evidence for a contribution from solar neutrinos. (UK)

57593 SPIN ASSIGNMENTS FOR SOME HIGHER EXCITED STATES IN ^{34}S. Jones, G. D.; Jayasinghe, E. M.; Mulhern, P. J.; Main, I. G.; Twin, P. J. (Univ. of Liverpool). J. Phys., A (London); 5: No. 7, 1073-89(Jul 1972).

The levels of ^{34}S from 5.4 to 7.3 MeV excitation energy were studied by particle-γ ray angular correlation experiments using the reaction ^{31}P(α,p)^{34}S. Spin assignments of 2, 3, 4, 4, 1, 2, and 2 were made to the levels at 5.680, 6.173, 6.250, 6.415, 6.480, 7.112, and 7.220 MeV, respectively. Spin restrictions were placed on other levels and some previous spin assignments were confirmed. Branching ratios were determined for many of the observed decay modes and multipole mixing ratios obtained for several transitions. (auth)

57594 α-PARTICLE AND γ-QUANTUM CORRELATION IN REACTION ^{27}Al(p,$\alpha_1\gamma$)^{24}Mg AT 6.40 MeV PROTON ENERGY. Vasil'ev, S. S.; Dem'yanova, A. S.; Zazulin, V. S.; (and others) (Moscow State Univ.). Yadern. Fiz.; 15: No. 4, 659-61(Apr 1972). (In Russian).

The angular correlation between α-particles from the reaction ^{27}Al(p,α_1)^{24*}Mg with a secondary nucleus ^{24}Mg in the first excited state and γ-quanta ($E_\gamma = 1.368$ MeV) produced from this state has been measured as a function of the γ-quanta production angle. The angle between proton beam and detector directions was 135° (l.s.). Proton energy was 6.40 MeV that corresponds to excitation function maximum. The reaction plane angle correlation is well described with the expression $W(\theta_\alpha = \text{const}, \theta_\gamma, \varphi = 0) \sim \Sigma_{k=0,2,4} A_k P_k \cos(\theta_\gamma - \theta_0)$ that confirms the resonance nature of the excitation function maximum. (auth)

Nuclear Properties and Reactions, $39 \leq A \leq 58$

Refer also to abstracts 56240, 57554, 57557, 57561, 57564, 57583, 57586, 57679, 57681, 57744, 57759, and 57760.

57595 (CONF-720901--4) keV NEUTRON TOTAL CROSS SECTION MEASUREMENTS AT ORELA. Harvey, J. A. (Oak Ridge National Lab., Tenn.). [nd]. 13p. Dep. NTIS.

From Meeting on new developments in reactor physics and shielding calculations; Kiamesha Lake, NY. (12 Sep 1972).

Neutron total cross sections are measured at ORELA using samples as small as a few square millimeters, flight paths from 18 to 200 meters, with energy resolutions ($\Delta E/E$) from 1/300 for measurements below ~10 keV to ~1/2500 up to 200 keV and and $\sqrt{E\text{(in MeV)}}/1000$ above 1 MeV. A new efficient neutron detector using NE 110 has been developed for keV measurements whose efficiency is ~30% for 10 keV neutrons rising to 90% for 50 keV neutrons. Transmission measurements using iron-filtered neutron beams have been made upon thick samples of iron 4", 6", 12", and 20" to obtain accurate values of the cross-section minima. Enriched ^{54}Fe and ^{57}Fe samples have been measured to determine their contributions to the windows in natural iron. (auth)

57596 (FRNC-TH-201) (p,d) AND (p,α) REACTIONS WITH EVEN CALCIUM ISOTOPES. Martin, Philippe (Universite Scientifique et Medicale de Grenoble (France)). 1972. 89p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The (p,d) and (p,α) reactions with ^{40}Ca, ^{42}Ca, ^{44}Ca, and ^{48}Ca were studied experimentally at 40 and 56.6 MeV, respectively. It is demonstrated that realistic results are obtained for the form factors in the analysis of (p,d) reactions, when the effective binding energy method is adopted in the framework of the DWBA. Studies of (p,α) reactions confirmed the J dependence of the angular distributions and the hypothesis that the (p,α) reaction proceeds, essentially, by a pick-up mechanism. It was possible to predict the relative cross sections for the various reactions and to accurately reproduce the form of the angular distribution from DWBA calculations. In both types of reaction, observation of various highly excited analogous levels enabled the Coulombian energy difference to be calculated and new levels to be proposed, or new spins for the level schemes of odd K isotopes. (62 references). (France)

57597 (ORNL-TM-3867(Rev.)) SDT1. IRON BROOMSTICK EXPERIMENT: AN EXPERIMENTAL CHECK OF NEUTRON TOTAL CROSS SECTIONS. Maerker, R. E. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 19p. (ENDF-166(Rev.)). Dep. NTIS.

The experimental and calculational details for a CSEWG integral data testing shielding experiment are presented. (auth)

57598 (UR-NSRL-43) STATIC ELECTRIC QUADRUPOLE MOMENTS OF THE FIRST EXCITED STATES OF ^{56}Fe AND THE EVEN TITANIUM NUCLEI. Lesser, P. M. S.; Cline, D.; Goode, Philip; Horoshko, R. N. (Rochester Univ., N. Y. Nuclear Structure Research Lab.). Nov 1971. 78p. Dep. NTIS.

The reorientation effect in Coulomb excitation was used to measure the static electric quadrupole moments of the first excited (2^+) states in ^{48}Ti and ^{56}Fe. These measurements yielded the following values: $Q_{2+}(^{48}\text{Ti}) = -13.5 \pm 7.5$ efm^2 and $Q_{2+}(^{56}\text{Fe}) = -24.9 \pm 5.8$ efm^2. Comparison with other measurements indicates that nuclear interaction effects produce spurious quadrupole moments if the distance of closest approach for 180° scattering is much less than $1.25\ (A_P^{1/3} + A_T^{1/3}) + 6.0$ fm. In the present measurements, the 2^+ states were excited by means of ^{32}S projectiles and the de-excitation gamma rays were observed in coincidence with scattered particles, using a multiple detector system. The angular distribution of de-excitation gamma rays was found to be significantly attenuated (deorientation effect) and it was crucial to include this effect in analyzing the reorientation data. Measurements of the attenuation were consistent with a magnetic dipole hyperfine interaction between the excited nuclear state and a randomly fluctuating atomic environment for ions recoiling into vacuum. The effective magnetic hyperfine field was observed to have a velocity dependence consistent with the form $H \propto (\beta)^x$, where β = recoil velocity/c and $x = 0.66 \pm 0.13$. The static quadrupole moments and other E2 properties of ^{56}Fe are characteristic of a relatively stiff prolate rotor, while ^{46,48}Ti exhibit properties of nuclei soft to collective quadrupole motion. Pure $(f_{7/2})^n$ shell model calculations for the even titanium isotopes cannot explain the E2 properties of the low-lying levels and predict static quadrupole moments of the wrong sign. The inclusion of configurations with one nucleon excited into the upper (1f-2p) shell yields a dramatic improvement, compared with the pure $(f_{7/2}^n)$ shell model results, in explaining the experimental E2 properties of ^{48}Ti. A similar, though not so striking, improvement holds for ^{46}Ti. The E2 properties of the ground state band in ^{56}Fe are adequately described by a 2-particle—2-hole shell model configuration, assuming an inert ^{56}Ni core. However, the calculation fails to reproduce the magnetic moment of the first excited state, as well as the electromagnetic properties of other low-lying levels, indicating the presence of appreciable admixtures of core-excited configurations in ^{56}Fe. (auth)

57599 METHOD OF DETERMINING PHOTONUCLEON CROSS SECTIONS FOR SEPARATE RESIDUAL NUCLEI STATES UTILIZING CONTINUUM GAMMA-RAY SOURCES. Brajnik, D.; Jamnik, D.; Kernel, G.; Miklavzic, U.; Snajder, J. (Univ. of Ljubljana, Yugoslavia). Nucl. Instrum. Methods; 103: No. 2, 189-96(1972).

An experimental setup for simultaneous measurement of photoprotons and de-excitation gamma rays in the giant resonance energy region is used for evaluation of photoparticle cross sections leading to different levels of residual nuclei. The system consists of a scattering chamber with four silicon surface-barrier detectors, allowing measurement of photoproton spectra at 8 angles between 30° and 150°, inclusive, and a Ge(Li) coaxial detector assembly for analyzing gamma rays from excited residual nuclei states. A least-squares method is adopted for the calculation of (γ,p) cross sections. Two types of data are used in the calculation: photoproton spectra of different bremsstrahlung end-point energies and the de-excitation gamma-ray spectra. The latter enable selection of those states in residual nuclei which are strongly populated in the reaction, and consequently reduce the number of free parameters in the least-squares analysis. Typical cross sections are presented to illustrate the effectiveness of the method. (auth)

57600 NONCONSERVATION OF P-PARITY IN γ-DECAY OF ^{41}K. Lobashov, V. M.; Nazarenko, V. A.; Lozovoi, N. A.; (and others) (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 15: No. 6, 1142-8(Jun 1972). (In Russian).

Non-conservation of P-parity in the γ-decay of ^{41}K produced in the β-decay of ^{41}Ar was investigated by measuring circular polarization of γ-quanta. An integral method of registering γ-quantum intensity and resonance selection of periodic signals was used. A stable and powerful radioactive ^{41}Ar source was obtained by means of circulating the gas being exposed in the reactor VVR-M in a close high-pressure loop with liquefaction of the active gas in the source. $P_\gamma = +(2.0 \pm 0.4) \cdot 10^{-5}$ was obtained for the 1290 keV γ-transition in ^{41}K. (auth)

57601 j-DEPENDENCE IN $l = 3$ TRANSITIONS IN (d,p) AND (p,d) REACTIONS. Delic, G ; Robson, B. A. (Australian National Univ., Canberra). Nucl. Phys.; A193: No. 2, 510-18(1972).

The effect of the deuteron D state on exact finite-range DWBA calculations was investigated for $l = 3$ transitions in the reaction ^{54}Cr(p,d)^{53}Cr leading to the 1.001-MeV ($5/2^-$) and 1.284-MeV ($7/2^-$) levels at 17.5 MeV proton bombarding energy. The effect upon the j dependence of the differential cross sections and the corresponding proton analyzing powers and deuteron vector and tensor polarizations was studied. Inclusion of the D state was found to have a much smaller j-dependence effect upon the differential cross section than is observed experimentally. (3 figures, 1 table) (auth)

57602 PROTON ELASTIC SCATTERING BY Ca NUCLEI IN THE ENERGY REGION 5.0 TO 6.4 MeV. Romanovskii, E. A.; Sirotinin, E. I.; Spasskaya, T. I.; Shishkin, K. S.; Aleshin, V. D. (Moscow State Univ.). Yadern. Fiz.; 15: No. 4, 655-8(Apr 1972). (In Russian).

Excitation functions of proton elastic scattering by Ca nuclei in the energy region 5.0 to 6.4 MeV are calculated using the thick target method. The results obtained are compared with those by other authors. It is shown that using this method one can obtain the information on averaged cross sections for proton elastic scattering by atomic nuclei. (auth)

57603 ^{54}Mn LEVELS. Mishchenko, V. M.; Popov, A. I.; Storizhko, V. E. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 15: No. 4, 617-24(Apr 1972). (In Russian).

The excitation functions, γ-ray angular distributions and nγ-correlations in the reaction ^{54}Cr(p,nγ)^{54}Mn at proton energies E_p = 2.6 to 3.1 MeV were measured. The processing of the experimental data from the statistical theory permits to determine spins of low-lying ^{54}Mn levels: 2^+, 3^+ (56 keV), 4^+ (156 keV), 4^+ (365 keV) and 3^+ (407 keV). The factors are determined of the multipole mixing for γ-rays accompanying the decay of these levels. (auth)

57604 STRUCTURE OF $1f_{7/2}$ NUCLEI. Proceedings of the Topical Conference, Padua, Italy, April 15—21, 1971. Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971). 548p. (CONF-710447).

All but one of the scientific papers presented at this conference are title-listed in this issue of NSA; the remaining paper has appeared as NSA 26: 21692. (R.W.R.)

For title listing of individual papers see: 56240, 56811, 56854, 57605, 57606—57665, 57679, 57759, and 57760.

57605 WHY $1f_{7/2}$ NUCLEI. Ricci, R. A. (Univ., Padua). pp 1-8 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57606 NUCLEAR STRUCTURE IN THE $1f_{7/2}$ SHELL. Zamick, L. (Rutgers—The State Univ., New Brunswick, N. J.). pp 9-36 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57607 EFFECTIVE INTERACTIONS FROM ONE- AND TWO-BODY SPECTRA IN THE $1f_{7/2}$ SHELL. Schiffer, J. P. (Argonne National Lab., Ill.). pp 37-59 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57608 CALCIUM REGION. Cindro, N. (Inst. Ruder Boskovic, Zagreb). pp 63-77 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57609 SHELL-MODEL CALCULATION OF N = 28 ISOTOPES WITH CORRECT TREATMENT OF THE ISOSPIN. Osnes, E. (Univ. of Oslo). pp 79-93 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57610 CORE EXCITATION EFFECTS IN THE CALCIUM REGION. Zuker, A. P. (CEN, Saclay, France). pp 95-109 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57611 DESCRIPTION OF SOME POSITIVE-PARITY LEVELS OF ^{40}Ca THROUGH THE ^{42}Ca(p,t)^{40}Ca REACTION. Schapira, J. P. (Institut de Physique Nucleaire, Orsay, France). pp 111 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57612 NEGATIVE-PARITY STATES IN ^{40}Ca UP TO 9 MeV EXCITATION. Tellez, A. (CEN, Saclay, France). pp 113-15 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57613 LEVEL STRUCTURE OF ^{42}Ca BY ^{41}K(^{3}He,d) AND ^{39}K(α,p) REACTIONS AT 10 MeV. Pellegrini, F. (Univ., Padua); Gentilin, F.; Filosofo, I. pp 117 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57614 γ-DECAY OF LOW-LYING STATES IN ^{42}Ti AND ^{42}Sc. Grawe, H.; Hartmann, R.; Kaendler, K. (Univ., Freiburg i. B.). pp 119-21 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei, Padua, Italy (15 Apr 1971). See CONF-710447.

57615 E2 ENHANCEMENT OF THE $2_1^+ \rightarrow 0_1^+$ TRANSITION IN ^{42}Ti. Brown, B. A.; Marmor, M.; Fossan, D. B. (State Univ. of New York, Stony Brook). pp 123 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57616 SINGLE-PARTICLE TRANSFER REACTIONS IN THE (fp) SHELL. Alford, W. P. (Univ., Munich). pp 127-41 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57617 DIRECT CHARGE-EXCHANGE REACTIONS IN $f_{7/2}$ NUCLEI. Bruge, G. (CEN de Saclay, Gif-sur-Yvette, France). pp 143-61 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447

57618 QUARTET STATES IN $1f_{7/2}$ NUCLEI. Ginocchio, J. N. (Yale Univ., New Haven). Contract AT(30-1)-3223. pp 163-72 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57619 FOUR NUCLEON TRANSFERS AND LOW-LYING QUARTET STATES IN $f_{7/2}$ NUCLEI. Faraggi, H. (CEN de Saclay, France). pp 173-88 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57620 (p,α) REACTIONS IN THE $1f_{7/2}$ REGION. Kulisic, P. (Inst. Ruder Boskovic, Zagreb); Falk, W. R. pp 191-2 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).
From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57621 STUDY OF THE $^{40}Ca(^3He,t)^{40}Sc$ REACTION AT 30.2 MeV. Loiseaux, J. M. (CEN, Saclay, France); Bruge, G.; Schaeffer, R.; (and others). pp 197-9 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).
From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57622 PROTON-PAIR CORRELATION IN Ti AND Cr LOW-LYING EXCITED STATES. Lemaire, M. C.; Loiseaux, J. M.; Mermaz, M. C.; Papineau, A.; Faraggi, H. (CEN de Saclay, Gif-sur-Yvette, France). pp 201-3 of Structure of $1f_{7/2}$ Nuclei /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).
From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57623 EXPERIMENTAL STUDY OF THE PAIRING VIBRATIONS IN THE REGION OF N = 28 BY $(^3He,p)$ REACTIONS. Shin, A.; Povh, B.; Wurm, P. (Max-Planck Institut fuer Kernphysik, Heidelberg). pp 205-6 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).
From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57624 $^{40}Ca(\alpha,\gamma)^{44}Ti$ REACTION. Chilosi, G. (Univ., Naples); Rossi-Alvarez, C.; Vingiani, G. B. pp 211-13 of Structure of $1f_{7/2}$ Nuclei. /Ricci, A. A. (ed.). Bologna; Editrice Compositori (1971).
From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57625 PARITY OF THE 3.168 MeV LEVEL OF ^{46}Ti. Guillaume, G.; Davison, N. E.; Wagner, P.; Franck, G.; Gallman, A. (Laboratoire de Physique Nucleaire et d'Instrumentation Nucleaire, Strasbourg). pp 215-17 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).
From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57626 EVIDENCE OF A $\nu[f^5_{7/2}.f_{5/2}]^+_0$ GROUND STATE COMPONENT IN ^{48}Ti FROM THE $^{47,48}(d,t)$ REACTIONS. Pohl, H.; Santo, R.; Wagner, G. J. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 219-25 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).
From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57627 PARTICLE EXCITATION FROM THE $1f_{7/2}$ SHELL TO THE $2p_{3/2}$, $1f_{5/2}$, $2p_{1/2}$ LEVELS AND THE LOW-LYING STATES OF ^{56}Ni, ^{58}Ni, ^{54}Fe, AND ^{56}Fe. Oberlechner, G.; Richert, J. (CRN, Strasbourg). pp 227 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).
From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57628 THERMAL NEUTRON CAPTURE REACTIONS IN THE $1f_{7/2}$-SHELL. Arnell, S. E. (Chalmers Univ. of Tech., Goteborg). pp 251-86 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).
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57665 RESULTS ARISING FROM SIMPLE CONFIGURATION ASSIGNMENTS IN $1f_{7/2}$ NUCLEI. Lawson, R. D. (Argonne National Lab., Ill.). pp 519-27 of Structure of $1f_{7/2}$ Nuclei. /Ricci, A. A. (ed.). Bologna; Editrice Compositori (1971).

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Nuclear Properties and Reactions, $59 \leq A \leq 89$

Refer also to abstracts 57240, 57256, 57586, 57620, 57655, 57664, 57686, and 57688.

57666 (COO-2186-4) STUDY OF LEVEL STRUCTURE OF ^{78}Kr AND THE DECAY PROPERTIES OF ^{78}Rb AND ^{78m}Rb$^+$. Bakhru, H. (State Univ. of New York, Albany); Ladenbauer-Bellis, I. M.; Jones, B. (Yale Univ., New Haven, Conn.). 19p. Dep. NTIS.

^{78}Rb and ^{78m}Rb were produced via the following heavy ion reactions: ^{65}Cu(^{16}O,3n)^{78,78m}Rb and ^{69}Ga(^{12}C,3n)^{78,78m}Rb. The half-lives of ^{78}Rb and ^{78m}Rb were measured and found to be 6.5 ± 0.5 min and 4.2 ± 0.2 min, respectively. The study of singles γ-ray spectra and the use of two large Ge(Li) detectors in connection with the PDP-8/I and a program for two-dimensional analysis with a 4096-dual analog-to-digital converter revealed the existence of several previously unreported transitions in ^{78}Kr. Decay schemes are proposed for ^{78}Rb and ^{78m}Rb, populating the following levels in ^{78}Kr: 455.1, 1119.7, 1148.0, 1564.9 and 1978.5 keV. Spin and parity assignments of some of the levels of ^{78}Kr are discussed. (auth)

57667 (COO-2186-5) ENERGIES AND INTENSITIES OF γ-RAYS IN THE DECAY OF ^{79}Sr. Ladenbauer-Bellis, I. M.; Bakhru, H.; Jones, B. (Yale Univ., New Haven, Conn.). [nd]. 6p. Dep. NTIS.

The decay of ^{79}Sr was studied using high-resolution Ge(Li) detectors. ^{79}Sr was produced via the ^{69}Ga(^{14}N,4n) reaction. The half-life of 4.4 ± 0.2 min was assigned to ^{79}Sr. A gamma ray of 105.4 ± 0.2 keV was assigned to the decay of ^{79}Sr. (auth)

57668 (IS-T-507) PHOTOPROTONS FROM ^{64}Zn. Clark, Gary Edwin (Ames Lab., Iowa). Aug 1972. Contract W-7405-eng-82. 82p. Dep. NTIS.

Thesis.

An absolute cross section for the reaction ^{64}Zn(γ,p)^{63}Cu was measured at four angles using 15- to 27-MeV bremsstrahlung from the Electron Prototype Accelerator at Los Alamos. Reaction strength was found in three regions of excitation energy. The strength at 16.5 MeV, with an isotropic angular distribution, was attributed to the main giant dipole resonance of the $T_< = 2$ states. The peak at 19 MeV, which exhibited the $\sin^2\theta$ distribution characteristic of direct dipole interactions, was assigned to the $T_> = 3$ giant resonance thereby resolving a controversy in the literature. The strength in the region near 22 MeV could be explained by the electric quadrupole interaction. The results were compared with recently published sum rules and estimates of the energy splitting of the isospin components. (auth)

57669 OBSERVATION OF POLARIZATION–ANALYZING POWER INEQUALITY IN THE REACTION ^{88}Sr(p,p′γ)^{88}Sr USING POLARIZED PROTONS. Boyd, R. N. (Stanford Univ., Calif.); Slater, D.; Avida, R.; (and others). Phys. Rev. Lett.; 29: No. 14, 955-8(2 Oct 1972).

The difference between the polarization and the analyzing power in the inelastic scattering of protons at isobaric analog resonances in ^{89}Y was determined by measuring the spin-flip probability of a polarized beam. The differences are large, and are sensitive to the structure of the resonances. (auth)

57670 NEW DETERMINATION OF THE HALF-LIFE OF ^{83}Rb. Brown, L. C. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem.; 34: No. 9, 2974-8(Sep 1972).

High-purity ^{83}Rb was prepared by bombardment of enriched ^{84}SrCO$_3$ targets with 22-MeV protons. The three principal nuclear reactions that yield ^{83}Rb under these irradiation conditions are: ^{84}Sr(p,2n)^{83}Y $\xrightarrow{\epsilon,\beta^+}$ ^{83}Sr $\xrightarrow{\epsilon,\beta^{+|}}$ ^{83}Rb, ^{84}Sr(p,pn)^{83}Sr $\xrightarrow{\epsilon,\beta^+}$ ^{83}Rb, and ^{84}Sr(p,2p)^{83}Rb. Enriched ^{84}Sr was selected as the target isotope to maximize the amount of ^{83}Rb produced with the proton beam energy available and to minimize production of other rubidium radioisotopes. The formation of all other long-lived radio-rubidium isotopes by decay of yttrium parents is prevented by stable strontium nuclides in the chain. The one chain that is not blocked, A = 85, yields a stable rubidium isotope. The only possible source of long-lived rubidium contamination would be direct formation via (p,α) or (p,2p) reactions on minor target components, e.g., ^{87}Sr(p,α)^{84}Rb or ^{87}Sr(p,2p)^{86}Rb. The decay of a high-purity ^{83}Rb sample was followed for more than five half-lives, and the half-life was redetermined to be 86.2 ± 0.1 days. (auth) (UK)

57671 CROSS-SECTIONS FOR (n,2n) REACTIONS ON Ga, As, Sm, Gd FOR 14.1 MeV NEUTRONS. Viktorov, D. V.; Zyablin, V. L. Yadern. Fiz.; 15: No. 6, 1099-1101(Jun 1972). (In Russian).

The activation method has been used in measuring the cross section of (n,2n) reaction for ^{69}Ga, ^{71}Ga, ^{75}As, ^{144}Sm, ^{154}Sm, and ^{160}Gd at 14.1 MeV. The cross sections are respectively $\sigma(^{69}\text{Ga}) = 989 \pm 40$; $\sigma(^{71}\text{Ga}) = 1166 \pm 58$; $\sigma(^{75}\text{As}) = 910 \pm 37$; $\sigma(^{144}\text{Sm}) = 1470 \pm 77$; $\sigma(^{154}\text{Sm}) = 2020 \pm 160$; $\sigma(^{160}\text{Gd}) = 1964 \pm 95$ mb. The experimental data are mainly in accord with those from other papers and with the calculations made in statistical theory. (auth)

57672 DETERMINATION OF THE CHARGE DENSITY DISTRIBUTION PARAMETER IN ^{60}Ni, ^{64}Zn, AND ^{66}Zn NUCLEI WITH THE METHOD OF ELECTRON ELASTIC SCATTERING. Litvinenko, A. S.; Shevchenko, N. G.; Afanas'ev, N. G.; (and others) (Physical-Technical Inst., Kazan). Yadern. Fiz.; 15: No. 6, 1104-8(Jun 1972). (In Russian).

The cross sections for elastic scattering of electrons with initial energy 225.0 ± 0.2 MeV on ^{60}Ni, ^{64,66}Zn in the angular range 51–90° have been measured. From processing the data in the high energy approximation, an increase of the parameters of Fermi charge density distribution c and t is obtained. Besides there has been found a rms radius $\langle r^2\rangle^{1/2}$ in transitting from one nuclei to another. The results are compared with the theoretical calculations. (auth)

57673 LIFE TIME OF 2.734 MeV ^{88}Sr LEVEL. Kaipov, D. K.; Kosyak, Yu. G.; Smirin, L. N.; Shubnyi, Yu. K. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz.; 15: No. 6, 1089-92(Jun 1972). (In Russian).

The method of nuclear resonance scattering is applied to the lifetime determination of the 2.734 MeV ^{88}Sr level. Radioactive ^{88}Rb in the form of a water Rb(OH) solution was used as source. The initial radiation microspectrum was calculated with taking into account the recoil nucleus slowing-down. The dependence of the average cross section for the 1.837 MeV γ-quantum resonance scattering on the 2.734 MeV ^{88}Sr level lifetime was obtained. The average cross section was measured $\bar{\sigma} = (1.71 \pm 0.12) \cdot 10^{-26}$ cm^2 from which it follows that 2.734 MeV ^{88}Sr level lifetime equals $(3.5^{+4.5}_{-1.5}) \cdot 10^{-13}$ sec. (auth)

57674 NUCLEAR POLARIZATION AND NMR OF ^{74}As IN Fe. Kaplan, Morton; Kittel, Peter; Johnston, P. D.; Stone, N. J. (Oxford Univ.). Nucl. Phys.; A193: No. 2, 410-16(1972).

Nuclear magnetic resonance was detected in radioactive ^{74}As nuclei polarized in Fe. The magnetic moment of the ^{74}As ground state ($I^\pi = 2^-$) is $|\mu| = 1.597 \pm 0.003$ n.m., and the sign of the internal field at As nuclei in Fe is positive. The measured γ-ray anisotropies require the predominance of $j_\beta = 0$ in the β transitions to the first 2^+ states in ^{74}Se and ^{74}Ge. (2 figures, 1 table) (auth)

57675 EXCITATION OF ^{64}Ni BY THE ^{65}Cu(t,α) REACTION. Heymann, G.; Cronje, P. M. (Council for Scientific and Industrial Research, Pretoria). Nucl. Phys., A193: No. 2, 357-66 (1972).

Angular distributions of α particles from the (t,α) reaction on ^{65}Cu were measured for 12-MeV incident tritons. Levels up to an excitation energy of 7 MeV in ^{64}Ni were studied with a resolution (FWHM) of 10 keV. Distorted-wave Born-approximation calculations were carried out and used to assign values to the angular momentum of the transferred protons, as well as to determine relative spectroscopic factors for the outer shell-model orbits. A possible connection between collective states of the ^{64}Ni core and the proton in the $2p_{3/2}$ orbit was investigated by comparison between these data and other proton pickup reactions on ^{65}Cu and the inelastic scattering of ^{3}He and α particles from ^{64}Ni. Evidence is found for a two-step process in the proton pickup reaction leading to known collective states of the core. (4 figures, 3 tables) (auth)

57676 SYSTEMATICS OF EXCITATION FUNCTIONS FOR FAST NEUTRON INDUCED (n,2n) REACTIONS. Krivan, V.; Muenzel, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). J. Inorg. Nucl. Chem.; 34: No. 10, 2989-99(Oct 1972).

Systematics for excitation functions for (n,2n) reactions are presented, based on the dependence of position and value of the maximum cross section, the half-width at half maximum and an asymmetry factor of the excitation function as a function of the atomic number of the target nucleus. The influence of a neutron excess is also discussed. These dependences were evaluated from published data and used to develop a procedure for constructing unknown excitation functions. The systematics were checked by comparing the activities calculated using the constructed excitation functions and the experimentally-determined activities from (n,2n) reactions on the target nuclei ^{59}Co, ^{75}As, ^{89}Y, ^{93}Nb, ^{127}I, ^{133}Cs and ^{169}Tm, using two different neutron spectra obtained by bombarding a thick Be converter with 33 and 53 MeV deuterons. In all cases except As the agreement was within 25%. Comparison of the results obtained with different neutron spectra yields hints for improving the constructed excitation functions. (auth) (UK)

57677 MEASUREMENT OF THE CROSS SECTION OF THE REACTION ^{80}Kr(n,γ)^{81}Kr FOR THERMAL NEUTRONS. Barabanov, I. R.; Pomanskii, A. A.; Ryasnyi, V. G. (Inst. of Nuclear Research, Moscow). JETP Lett. (USSR) (Eng. Transl.); 15: No. 11, 456-7(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 643-5(5 Jun 1972).

A direct measurement of the ^{80}Kr thermal neutron capture cross section was made using a special multifilament cylindrical proportional counter. A value of 15.6 ± 1.96 was obtained. (J.W.R.)

57678 ^{87}Sr AND ^{93}Zr FLUORESCENCE AFTER THE CAPTURE OF THERMAL NEUTRONS. Groshev, L. V.; Govor, L. I.; Demidov, A. M. (Inst. of Atomic Energy, Moscow). Yadern. Fiz. 15: No. 4, 625-8(Apr 1972). (In Russian).

The results are reported of measurements of the ^{87}Sr, ^{91,93}Zr γ-ray spectra from the (n,γ)-reaction with thermal neutrons on enriched samples. The energies and intensities of the observed γ-lines of these nuclei and the ^{87}Sr and ^{93}Zr levels being populated through cross-over transitions from the initial excited state are given. ^{87}Sr and ^{93}Zr fluorescence peculiarities in the (n,γ)-reaction are discussed. (auth)

57679 ATTEMPT TO CLASSIFY EVEN NICKEL LEVELS BY THEIR ELECTROMAGNETIC PROPERTIES. Beuzit, P.; Delaunay, J.; Fouan, J. P. (CEN de Saclay, Gif-sur-Yvette, France). pp 431-3 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 55817, 56845, 57256, 57583, 57671, 57676, and 57678.

57680 (CNEA–304) ANOMALOUS ^{96}Zr RESONANCE INTEGRAL TO THERMAL ACTIVATION CROSS-SECTION RATIO AND NEUTRON ACTIVATION RESONANCE INTEGRAL OF ^{94}Zr AND ^{96}Zr. Ricabarra, M. D.; Turjanski, R.; Ricabarra, G. H. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Oct 1971. 21p. (In Spanish). INIS

The values of the relation of the resonance integral of activation relative to the effective thermal cross section, I'/σ_0, of ^{96}Zr and ^{94}Zr were determined using gold as the standard, measuring relative to cadmium in the neutron spectra of a reactor. Owing to the anomoly in the value of I'/σ_0 for ^{96}Zr, a measurement was made of the "quasithermal" spectrum. The activation resonance integrals for ^{96}Zr and ^{94}Zr were also determined measuring the true effective cross section of zirconium relative to ^{55}Mn. The absolute activities of the samples were determined by comparison with calibrated gamma sources. The measurements of activity were made in a gamma spectrometer with lithium-drifted germanium. The results obtained for ^{96}Zr are: $I'/\sigma_0 = 879 \pm 96$, $I' = 4.79 \pm 0.50$ b, and $\sigma_0 = 5.7 \pm 1.0$ mb; for ^{94}Zr: $I'/\sigma_0 = 5.87 \pm 0.05$, $I' = 0.369 \pm 0.037$ b, and $\sigma_0 = 63 \pm 8$ mb. The value of I'/σ_0 for ^{96}Zr is, by an order of magnitude, greater than has been obtained for stable isotopes. This suggests that almost 100% of the activation in the resonance integral of ^{96}Zr results from p-capture. This fact cannot be explained in terms of strength functions actually known for the region $90 < A < 130$. (tr-auth)

57681 NEW FEATURE OF 1–3 DIRECTIONAL CORRELATIONS WITH MIXED UNOBSERVED TRANSITIONS. Anicin, I. V.; Vukanovic, R. B.; Kukoc, A. H. (Inst. of Nuclear Sciences, Belgrade). Nucl. Instrum. Methods; 103: No. 2, 395-6(1972).

It is shown that 1–3 directional correlations with mixed unobserved transitions are, in general, parity sensitive. Consequences are briefly discussed. (2 figures) (auth)

57682 SIMPLE METHOD FOR ACCURATE MEASUREMENTS OF TOTAL INTERNAL CONVERSION COEFFICIENTS. Raman, S. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods; 103: No. 2, 407-9(1972).

A simple method employing a Ge(Li) detector for determining total internal conversion coefficients is described. This method can significantly increase the number of accurately known conversion coefficients of high-multipolarity ($\Delta L \geq 3$) transitions. When an isomer de-excites via two transitions in cascade, one of which has a small total conversion coefficient (determined from theory or experiment), it is possible to deduce the other (high) conversion coefficient by measuring relative photon intensities only. This method is demonstrated by measuring the total conversion coefficient of the 88.5-keV, M4 transition occurring in the $11/2^-$ (120-d ^{123}Te isomer) $\rightarrow$ $3/2^+$ (159.0-keV level) $\rightarrow$ $1/2^+$ (^{123}Te ground state) cascade. The experimental value is 1076 ± 42, compared to the theoretical value of 1149. (2 figures) (auth)

57683 MAGNETIC MOMENT OF THE $11/2^-$ ISOMER OF ^{125}Te. Silverans, R. E.; Coussement, R.; Dumont, G.; Pattyn, H.; Vanneste, L. (Univ. Louvain, Belg.). Nucl. Phys.; A193: No. 2, 367-71(1972).

In nuclear orientation experiments on ^{125m}Te, implanted in iron, the anisotropy of the 109.5-keV γ ray, from the $11/2^- - 3/2^+$ transition, was observed. By using the hyperfine field of tellurium in iron, the magnetic moment of the $11/2^-$ state was derived: $\mu = -(0.93 \pm 0.05)$n.m. The g factor of this state is compared to values reported for the g factor of the $9/2^-$ "intruder" state in ^{125}Te: this confirms the three-quasi-particle description of the latter state. (auth)

57684 DECAY OF THE LIGHT ANTIMONY ISOTOPES $^{110\ 111\ 112\ 113\ 114}$Sb FOLLOWING THE $^{112\ 114}$Sn(p,xn) REACTIONS. Singh, M.; Sunier, J. W.; DeVries, R. M.; Thompson, G. E. (Univ. of California, Los Angeles). Nucl. Phys.; A193: No. 2, 449-69 (1972).

The decay of the two new isotopes ^{110}Sb ($T_{1/2}$ = 23.0 s) and ^{111}Sb ($T_{1/2}$ = 74.1 s) is investigated following the ^{112}Sn (p,xn) reactions, together with the decay of ^{112}Sb ($T_{1/2}$ = 53.5 s), ^{113}Sb ($T_{1/2}$ = 6.74 min), and ^{114}Sb ($T_{1/2}$ = 3.52 min). The Q_{EC} values of ^{112}Sb, ^{111}Sb, and ^{110}Sb are measured to be 7.03 ± 0.05, 4.47 ± 0.05, and 9.08 ± 0.10 MeV, respectively. The spin and parity of the even isotopes ^{110,112,114}Sb are deduced to be 3^+, while the spin and parity of ^{111,113}Sb are shown to be $5/2^+$. Decay schemes are proposed and discussed. An isomeric state (8^-) in ^{114}Sb, with a half-life of 8 ± 2 min, is suggested from the data. (15 figures, 5 tables) (auth)

57685 LIFETIME OF THE 321 keV ($9/2^-$) STATE IN ^{125}Te. Satyanarayana, G.; Ramamurty, V. V.; Lakshminarayana, V. (Andhra Univ., Waltair, India). J. Phys., A (London); 5: No. 8, 1243-7(Aug 1972).

The half-life of the 321 keV ($9/2^-$) state in ^{125}Te is measured by the delayed coincidence technique employing a time-to-amplitude converter. On comparing the experimental M1 and E2 transition probabilities with those evaluated by the single particle model, Kisslinger's (1963) three-quasiparticle model and the De-Shalit (1961) model, it is found that De-Shalit's single particle-core coupling model is applicable in this case. (auth) UK)

57686 STUDY OF MEDIUM WEIGHT NUCLEI BY (γ,p) REACTION. Shoda, Katsufusa; Sugawara, Masumi; Saito, Teijiro; Miyase, Haruhisa; Oikawa, Siro (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 4: No. 1, 30-41(Sep 1971). (In Japanese).

Nuclei with neutron number of 50 and neodymium nuclei were investigated with an electron linear accelerator. The nuclei with neutron number of 50 were bombarded by electrons, and emitted protons were analyzed with a broad band magnetic spectrometer. The obtained proton yield curves were analyzed by the photo-difference method and the least square method. Results show that cross section for (γ,p) reaction is small in the giant resonance region and very large at an energy of around 20 MeV. Dependence of excitation cross sections of isobaric analog states on neutron number was studied for neodymium nuclei ^{142}Nd, ^{144}Nd, ^{146}Nd, ^{148}Nd and ^{150}Nd. Emitted proton spectra were observed at an angle of 125.3° for incident electron energy of around 23 MeV and around 20 MeV. Peaks due to the isobaric analog states were clearly seen. Total proton yield was measured as function of the electron energy. Radiative widths Γ were calculated from the observed yield curve. Peak energies, radiative widths and integrated cross sections are shown in a table, and results for ^{140}Ce and ^{141}Pr were also shown in the same table for comparison. (Japan)

57687 NEW ^{92}Ru NEUTRON-DEFICIENT ISOTOPE. Arlt, R.; Bayar, B.; Kracik, B.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). J. Inorg. Nucl. Chem.; 34: No. 10, 3001-5(Oct 1972).

Both the growth and the decay of gamma-lines of the daughter ^{92}Tc isotope and the direct decay of ^{92}Ru were observed. The half-life of the new ^{92}Ru isotope was determined to be $T_{1/2}$ = (3.16 ± 0.33)min. The energies and the relative intensities of the ^{92}Ru gamma-rays are: (134.68 ± 0.09) keV (57 ± 8); 213.94 ± 0.11) keV (84 ± 13); (259.41 ± 0.09) keV (100). (auth) (UK)

57688 CROSS SECTIONS AND ISOMER RATIOS FOR SOME NEUTRON CAPTURE REACTIONS. Rao, A. L.; Rao, J. R. (Andhra Univ., Waltair, India). J. Phys., A (London); 5: No. 8, 1262-5(Aug 1972).

Neutron capture cross sections leading to the isomeric states in seven nuclei were measured, for the first time, using the activation technique and absolute gamma counting method, employing an antimony-beryllium neutron source and a calibrated well-type NaI(Tl) crystal. In two reactions, ^{116}Cd(n,γ)^{117m,g}Cd and ^{151}Eu(n,γ)^{152m_1,m_2}Eu where cross sections were measured for a pair of states in each case, the "isomeric cross section ratio" was employed to extract the spin cutoff factor following Huizenga and Vandenbosch (1960) formalism. A comparison is made with theoretical predictions based on various models of level density to throw light on the nuclear moments of inertia. (auth) (UK)

57689 MEASUREMENT OF THE MEAN LIFE OF THE 2412 keV 3^+ LEVEL OF THE ^{140}Ce NUCLEUS. Bourgeois, Christian; Letessier, Jocelyne; Foucher, Roger (Univ. Paris, Orsay, France). Compt. Rend., Ser. B; 274: No. 22, 1249-52 (29 May 1972). (In French).

In order to determine the characteristics of the 2412 keV 3+ level of ^{140}Ce, a delayed β–γ coincidence method was used to measure its mean life. The half-life of this level was established to be 55 ± 15 psec. The existence of a half-life of 42 ± 11 psec associated with a level situated between 2500 and 2550 keV was also established. (France)

57690 RATIOS OF THE INTERNAL CONVERSION COEFFICIENTS FOR M4-TRANSITIONS IN NUCLEI $^{121\ 123\ 125\ 127\ 129}$Te. Kalinauskas, R. A.; Makaryunas, K. V.; Davidonis, R. I. (Inst. of Mathematical Physics, Vilnyus, USSR). Yadern. Fiz.; 15: No. 4, 631-6(Apr 1972). (In Russian).

Spectra of the internal conversion electrons of the M4-transitions in nuclei ^{121,123,125,127,129}Te were investigated with a prismatic β-spectrometer. The ratios $K : L : M : (N + O)$ (for all the nuclei), $L_I : L_{II} : L_{III}$ (for ^{123,125,127,129}Te) and $M_I : M_{II+III} : M_{IV+V}$ for ^{125,127,129}Te were measured. Some discrepancies between experimental results and theoretical data are pointed out. (auth)

Nuclear Properties and Reactions, $150 \leq A \leq 189$

Refer also to abstracts 57557, 57671, 57676, 57681, and 57688.

57691 (COO–1672–33) NEW HIGH-SPIN ISOMER 2.3 d ^{198m}Au AND THE ^{198}Au LEVEL STRUCTURE. Cunnane, J. C.; Daly, P. J. (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). 1972. 9p. Dep. NTIS.

The decay of a new high-spin isomer in ^{198}Au was studied. A revised interpretation of the results of earlier (n,γ) and (d,pγ) studies is presented and shell-model assignments for the levels populated in the ^{198m}Au decay are proposed. (auth)

57692 (NP–19389) NUCLEAR SCATTERING OF PLANE-POLARIZED 15.11 MeV PHOTONS FROM Bi, Au, AND Ta. Sazama, Franklin Jed (American Univ., Washington, D. C. Dept. of Physics). Jul 1972. 97p.

Thesis.

A beam of plane-polarized 15.11 MeV photons has been developed by resonance fluorescence of the 1^+ state in ^{12}C with 20 MeV bremsstrahlung. The photon beam is 18 cm in diameter and is estimated to contain approximately 10^4 photons per second with a conventional polarization of 0.96. These photons are then scattered from targets of bismuth, gold and tantalum. A measurement of the number of photons scattered parallel and perpendicular to the polarization vector in the incident 15.11 MeV beam has been made and allows a determination of the relative contribution of incoherent and coherent scattering to the total scattering cross section. Expressed in terms of the ratio $\eta = (d_\sigma{\parallel}/d_\Omega)/(d_\sigma{\perp}/d_\Omega)$ the results are 0.019 ± 0.058 for bismuth, 0.168 ± 0.056 for gold and 0.138 ± 0.073 for tantalum. These results are compared with predictions of the hydrodynamic (Danos – Okamoto) and dynamic collective models. (auth)

57693 TRANSITION PROBABILITY IN ^{177}Ta. Ader, Bertrand; Berg, Valter; Letessier, Jocelyne; Ohlsson, Harriet (Univ. Paris, Orsay, France). Compt. Rend., Ser. B; 274: No. 14, 900-3(5 Apr 1972). (In French).

The half-lives of the 216.6, 372.6, and 497.4 keV levels were measured. The values obtained are respectively: (0.072 ± 0.04) nsec, <0.1 nsec, and (0.44 ± 0.02) nsec. The partial transition probabilities deduced from these results were compared with theoretical values. (France)

57694 TIME-DIFFERENTIAL MEASUREMENT OF NUCLEAR DEORIENTATION FOR RECOILS IN VACUUM. Ward D. Graham, R. L.; Geiger, J. S.; Andrews, H. R.; Sie, S. H. (Chalk River Nuclear Labs., Ont.). Nucl. Phys.; A193: No. 2, 479-88 (1972).

Angular distributions of the $2^+ \to 0^+$ γ ray from aligned ^{150}Sm nuclei recoiling in vacuum ($v/c = 1.90\%$) were measured for transit times in the picosecond range. The coefficients A_2 and A_4 were found to decay exponentially. The ratio of the decay constants $\tau_2/\tau_4 = 2.5 \pm 0.2$ is to be compared with the magnetic interaction prediction of 10/3. It is found that $\tau_2 = 40 \pm 4$, $\tau_4 = 16 \pm 1.5$ ps, and the correlation parameter $\tau_c < 5$ ps. The results are compared with several theories. (4 figures) (auth)

57695 GROUND STATE ROTATIONAL BANDS IN ^{150}Sm AND ^{152}Sm. Hartley, A. J.; Chapman, R.; Dracoulis, G. D.; (and others) (Univ. of Manchester, Eng.). J. Phys., A (London); 5: No. 8, L69-73(Aug 1972).

The gamma rays from the ^{150}Nd(α,4n)^{150}Sm and ^{150}Nd(α,2n) ^{152}Sm reactions were studied in both singles and coincidence. The ground state rotational bands in ^{150}Sm are populated up to the state with spin 10^+. It is found that the nuclear moment of inertia of ^{150}Sm is substantially lower than that of ^{152}Sm for the low spin states, but that it increases with spin and the moments of inertia converge for the high spin states. This supports earlier evidence that the change from spherical to deformed nuclei between N = 88 and N = 90 is gradual. (auth)

57696 LEVELS OF ^{165}Er EXCITED IN THE DECAY OF ^{165}Tm. Marguier, G.; Chery, R. (Univ. Lyon, Villeurbanne, France). J. Phys. (Paris); 33: No. 4, 301-14(Apr 1972). (In French).

The decay of ^{165}Tm was studied using $\gamma-\gamma$ and $e-\gamma$ coincidence techniques. New levels were observed in ^{165}Er at 62.7 keV, 97.9 keV, 519.1 keV, 534.9 keV, 1416.8 keV, and 1527.5 keV. The negative parity states were identified with the theoretical states calculated in the framework of the quasi-particle model, taking into account quasi particle-phonon interactions. (France)

57697 COULOMB EXCITATION STUDIES OF ^{151}Eu AND ^{153}Eu. Thun, J. E.; Miller, T. R. (Stanford Univ., Calif.). Nucl. Phys.; A193: No. 2, 337-56(1972).

Coulomb excitation studies of ^{151}Eu and ^{153}Eu were performed using ^{35}Cl ions of energies from 30 to 90 MeV and α particles of energies from 8 to 12 MeV. In ^{151}Eu, $\gamma-\gamma$ coincidence experiments were performed to reduce uncertainties in the very complicated level structure. The existence of two close-lying levels at 307.0 and 307.45 keV was confirmed. Angular distribution measurements were performed with 40- and 60-MeV ^{35}Cl ions, and spin – parity values were obtained for the following levels; 503.5 keV, $9/2^+$; 307.45 keV $5/2^+$; 196.45 keV, $3/2^+$. The following E2/M1 mixing ratios were found: $\delta(482) = 0.32(8)$, $\delta(307.45) = -0.40(10)$, $\delta(286.1) = 0.30(10)$, $\delta(196.45) = -0.9(4)$. Earlier B(E2) measurements were confirmed, and improved energy determinations were obtained for several of the levels. In ^{153}Eu the E1 transition from the ground state to the 97.43-keV level was observed; and the B(E1) value, measured. The B(E2) of the 103.18-keV transition was measured, and several earlier B(E2) measurements were confirmed. Improved energy determinations were obtained for several of the levels. (10 figures 6 tables) (auth)

57698 MAGNETIC MOMENT OF THE 3^-, 1374-keV LEVEL OF ^{182}W. Singh, Bhupender; Dhar, Ashok. K.; Singh, Vikram; Hans, H. S. (Panjab Univ., Chandigarh, India). J. Phys. Soc. Jap.; 33: No. 4, 898-901(Oct 1972).

The reversed field method in a time-integrated directional correlation measurement has been used to determine the magnetic moment of the 3^-, 1374-keV level of ^{182}W. An external magnetic field of 15 kOe has been used for the perturbation of the 179 – 152 keV cascade of ^{182}W. The magnetic moment has been obtained to be μ(1374 keV) = +1.74 ± 0.16 n.m. The measured value of the magnetic moment establishes the 1374-keV level as a member of the K = 2 rotation band of ^{182}W. (auth)

Nuclear Properties and Reactions, $190 \leq A \leq 219$

Refer also to abstracts 55817, 57554, 57564, 57688, 57692, and 57744.

57699 (JINR–P3-6545) NEUTRON RESONANCES OF IRIDIUM ISOTOPES. Lason, L.; Maletski, Kh.; Pikel'ner, L. B.; Salamatin, I. M.; Sharapov, E. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1972. 11p. (In Russian). Dep. NTIS (U. S. Sales Only).

Measurement of neutron radiative capture by ^{191}Ir and ^{193}Ir was accomplished by the time-of-flight method in the pulsed reactor IBR with an injector. The energies of 106 resonances were determined, and for the majority of which values of $g\Gamma_n$ were obtained. (tr-auth)

57700 (RLO–1388–187) LIFETIME OF THE O_2^+ STATE OF ^{206}Pb AND THE STATE DEPENDENCE OF THE MONOPOLE EFFECTIVE CHARGE. Tape, J. W.; Adelberger, E. G.; Burch, D (Washington Univ., Seattle. Dept. of Physics); Zamick, Larry (Rutgers–The State Univ., New Brunswick, N. J. Dept. of Physics). 1972. 9p. Dep. NTIS.

The mean lifetime of the O_2^+ state of ^{206}Pb is found to be 0.97 ± 0.10 ns. This corresponds to a monopole strength $\rho = (2.6 \pm 0.3) \times 10^{-2}$ and $B(E2 : O_2^+ \to 2_1^+) < 2.0\ e^2f^4$. The E0 strength can be accounted for with standard shell model wave functions using a state dependent monopole effective charge derived from isotope shift data. (auth)

57701 (TID–26140) FUNDAMENTAL NUCLEAR ENERGY RESEARCH REPORT. (Yale Univ., New Haven, Conn. Nuclear Structure Lab.). 23 Feb 1972. Contract AT(11-1)-3074. 18p. Dep. NTIS.

Research at the A. W. Wright Nuclear Structure Laboratory at Yale University is briefly summarized. (J.W.R.)

57702 p-WAVE NEUTRON RESONANCES IN ^{203}Tl AND ^{205}Tl. Thomas, G. E.; Bollinger, L. M. Cote, R. E. (Argonne National Lab., Ill.). Nucl. Phys.; A193: No. 2, 643-6(1972).

Neutron-transmission measurements on a thick sample of normal thallium revealed weak resonances at 38.0 and 44.6 eV. Neutron-capture γ-ray measurements by Bartholomew et al. have shown that the 39-eV resonance belongs to ^{203}Tl, and the 45-eV resonance, to ^{205}Tl. Parameters for the new resonances were obtained by curve-fitting the transmission data. The small values of the neutron widths indicated that both resonances are almost surely excited by p waves. (1 figure, 1 table) (auth)

57703 INELASTIC 13.7 MeV NEUTRON SCATTERING ON LEAD ISOTOPES. Belovitskii, G. E.; Kolesnikova, L. N.; Frank, I. M. (Inst. of Nuclear Research, Moscow). Yadern. Fiz.; 15: No. 4, 666-9(Apr 1972). (In Russian).

Energy spectra for inelastic 13.7 MeV neutron scattering on ^{206,207,208}Pb isotopes have been measured. A well distinguished group which corresponds to 2.6 MeV (3^-)-level excitement is observed in the energy spectra. The angular neutron distributions for the inelastic scattering with known ^{206,207,208}Pb (3^-)-level excitement are similar. The angular distributions were compared with ones calculated in the optical model in a distorted wave approximation. The value of the octupole deformation parameter $\beta_3 = 0.16 \pm 0.02$ was obtained for ^{208}Pb. (auth)

57704 ANGULAR DISTRIBUTIONS OF NEUTRONS WITH ENERGY 13.7 MeV ELASTICALLY SCATTERED ON $^{206\ 207\ 208}$Pb ISOTOPES. Belovitskii, G. E.; Kolesnikova, L. N.; Frank, I. M. (Inst. of Nuclear Research, Moscow). Yadern. Fiz.; 15: No. 4, 662-5(Apr 1972). (In Russian).

Angular distributions of 13.7 MeV neutrons were measured for elastic scattering on ^{206,207,208}Pb. The three angular distributions are not distinguished in the accuracy limits. It is explained by a potential for 14 MeV neutron scattering on heavy nuclei. Experimental data were compared with ones calculated in the optical model. Satisfactory consistency is observed. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 57554, and 57557.

57705 (EURFNR–1009) MEASUREMENT OF THE RATIO OF CAPTURE TO FISSION CROSS-SECTION FOR ^{235}U AND ^{239}Pu BETWEEN 8 AND 60 keV NEUTRON ENERGY. Bandl, R.-E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Translated from report KFK–1563. 87p. Dep. NTIS.

Work performed under the United States–EURATOM Fast Reactor Exchange Program.

The ratio of capture to fission cross section, α, has been measured for ^{235}U and ^{239}Pu in the neutron energy range from 8 to 60 keV. A 3 MV Van-de-Graaff accelerator generated a pulsed proton-beam. The ^{7}Li(p,n)^{7}Be reaction was used as the neutron-source. The absorption was found by a comparison of the scattered neutrons from a fissile sample with those from a non-absorbing lead sample. Simultaneously the fast fission neutrons were detected with an organic liquid scintillator. The neutron energy was determined by the time-of-flight method, the time resolution was about 20 ns/m. The measurements were normalized between 40 and 50 keV to the results of recent evaluations. The error in α amounts to 15% between 10 and 40 keV neutron energy. (auth)

57706 (LA–4901) EVALUATED NEUTRON-INDUCED GAMMA-RAY PRODUCTION CROSS SECTIONS FOR ^{239}Pu AND ^{240}Pu. Hunter, R. E.; Stewart, L. (Los Alamos Scientific Lab., N. Mex.). Jul 1972. Contract W-7405-eng-36. 18p. Dep. NTIS.

The gamma-ray production cross sections produced by neutron interactions from 10^{-5} eV to 20 MeV have been evaluated for ^{239}Pu and ^{240}Pu. The data were prepared for input into the ENDF/B format. Below 1 MeV, the "prompt" fission and radiative capture spectra are included along with the gammas from inelastic scattering. Above 1 MeV, the total gamma-ray production cross sections from all nonelastic processes are input as a single reaction because the experimental measurements did not discriminate between the individual reaction channels. At all energies, all gamma rays are assumed to be emitted isotropically. (auth)

57707 (LA–5042) FISSION CROSS SECTION OF ^{249}Cf FROM PHYSICS-8, TABLE OF VALUES. Silbert, M. G.; Lougheed, R. W.; Evans, J. E.; Hoff, R. W. (Los Alamos Scientific Lab., N. Mex.). Sep 1972. Contract W-7405-eng-36. 39p. Dep. NTIS.

Among the measurements carried out on the Physics-8 nuclear explosion was a neutron time-of-flight determination of the fission cross section of ^{249}Cf. The 100-μg sample was prepared and assayed at LLL. A silicon semiconductor fission-fragment detector at 90° to the neutron beam measured the signal due to ^{249}Cf(n,f), while similar detectors viewing ^{235}U and ^{6}Li samples determined the neutron flux. The values of neutron energy, fission cross section, and over-all fractional error (standard deviation) are given. The over-all error includes a ±6% systematic error, relative to the reference cross sections ^{235}U(n,f) and ^{6}Li(n,αt), which was combined quadratically with the nonsystematic error at each point. (auth)

57708 (UCRL–51263) THERMAL NEUTRON CAPTURE CROSS SECTION OF ^{235}Np. Landrum, Jerry H.; Nagle, Richard J.; Lindner, Manfred (California Univ., Livermore. Lawrence Livermore Lab.). 16 Aug 1972. Contract W-7405-eng-48. 5p. Dep. NTIS.

A neptunium sample containing roughly comparable levels of ^{235}Np, ^{236m}Np, and ^{237}Np was irradiated in the thermal column of the Livermore pool-type reactor (cadmium ratio = 17) in a flux of $\sim 2 \times 10^{11}$ n/cm^2/sec. A thermal capture cross section of 148 b was measured for the reaction $^{235}\text{Np}(n,\gamma)\ ^{236g}\text{Np} \xrightarrow[\beta^-,K]{22h}$ by comparing the ^{236}Pu produced with the ^{238}Pu produced by the reaction $^{237}\text{Np}(n,\gamma)\ ^{238}\text{Np} \xrightarrow{2d\beta}\ ^{238}\text{Pu}$. The latter cross section was taken to be 170 b. It was assumed that 50% of the ^{236g}Np decays resulted in β^- emission to ^{236}Pu. (auth)

57709 APPLICATION OF THE HELIUM-JET TECHNIQUE FOR FISSION FRAGMENT TRANSPORT FROM SPONTANEOUS FISSION SOURCES. Wien, K.; Fares, Y.; Macfarlane, R. D. (Texas A and M Univ., College Station). Nucl. Instrum. Methods; 103: No. 2, 181-7(1972).

The helium-jet method was adapted for the transport of fission products from a ^{252}Cf source. It was found that the helium carrier gas must be seeded with H_2O vapor and irradiated with an ultraviolet light source to obtain high efficiencies. There is indication of the role of free radicals in producing high-molecular-weight species that are necessary for the transport of the fission products. Transport efficiencies of about 55% and mean transport times of 30 s were achieved. (6 figures) (auth)

57710 FISSION CROSS SECTIONS OF ^{237}Np FROM 20 eV TO 7 MeV DETERMINED FROM A NUCLEAR-EXPLOSIVE EXPERIMENT. Jiacoletti, R. J. (Los Alamos Scientific Lab., N. Mex.); Brown, W. K.; Olson, H. G. Nucl. Sci. Eng.; 48: No. 4, 412-19 (Aug 1972).

The ^{237}Np(n,f) cross section has been measured relative to the ^{235}U(n,f) cross section from 20 eV to 7 MeV, including the range where no data previously existed (4 to 24 keV). Energies of the source neutrons from the Physics 8 underground nuclear explosion were determined by measuring the time-of-flight from the source to the neptunium target foil. The current signals produced in solid-state detectors by fission fragments were photographically recorded and converted to cross sections using the neutron flux measured with ^{235}U(n,f) and ^{6}Li(n,α)T reactions. Subthreshold resonances were observed in the ^{237}Np(n,f) cross section. The maximum value of the cross section observed just above threshold is 1.9 b at 2.26 MeV. A comparison of results with some previously reported values is presented. (auth)

57711 KINETIC ENERGY DISTRIBUTION IN THE THERMAL NEUTRON FISSION OF ^{233}U AND ^{239}Pu. Prakash, S.; Manohar, S. B.; Dange, S. P.; Ramaswami, A.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay). J. Inorg. Nucl. Chem.; 34: No. 9, 2685-97(Sep 1972).

Recoil ranges of fission products in the thermal neutron fission of ^{233}U and ^{239}Pu were determined using radiochemical techniques as well as direct counting with a Ge(Li) detector. The recoil ranges were converted into kinetic energies using different range-energy equations and the relative merits of these equations are discussed. The kinetic energy deficit was calculated from the kinetic energy distribution. From the kinetic energy distribution the average kinetic energy was calculated using the mass-yield data available in literature. The average kinetic energy was found to vary linearly with the fissionability parameter. Deformations of fission fragments and the variation of the deformation as a function of fragment mass were calculated using the kinetic energy data. (auth) (UK)

57712 ANGULAR MEASUREMENTS OF γ-RADIATION YIELD IN TRIPLE FISSION OF ^{252}Cf. Ivanov, O. I. Yadern. Fiz.; 15: No. 6, 1121-3(Jun 1972). (In Russian).

The results on angular measurements of γ-quantum yield in ternary fission of ^{252}Cf are presented. The observed equality of γ-quantum yields in binary and ternary fissions confirms the equality of mean angular moments of fragments in the two types of fission. It is shown, that γ-quantum yield anisotropy $A_{tr} = 0.015 \pm 0.022$ in ternary fission is negligibly small as compared with that in binary fission $A_{db} = 0.127 \pm 0.003$. An assumption on depolarization of angular moments of fragments in ternary fission is made. (auth)

57713 CALCULATION OF HALF-LIVES FOR SUPERHEAVY NUCLEI. Fiset, E. O. (Brooklyn Coll.); Nix, J. R. Nucl. Phys.; A193: No. 2, 647-71(1972).

The half-lives of superheavy nuclei with respect to spontaneous fission, α decay, and β decay (including electron capture) were calculated. The half-lives were calculated from fission barriers and decay energies that had been obtained by means of the macroscopic—microscopic method applied to realistic diffuse-surface single-particle potentials. The results indicate that the longest total half-life is $10^{9.4}$ y for the nucleus $^{294}110$, which decays predominantly by the emission of α particles. As a general rule, the predominant decay mode is α emission for nuclei containing more than 110 protons or a few more neutrons than 184, β emission for nuclei containing less than 110 protons, and spontaneous fission for nuclei containing either less than 184 neutrons or substantially more. Therefore, if nuclei in the vicinity of $^{304}122$ could be formed successfully in their ground states, they should decay primarily by the rapid emission of a series of high-energy α-particles; this provides a simple identification method. However, once the closed proton shell at $Z = 114$ is reached, electron capture becomes the predominant decay mode. This leads to nuclei whose calculated total half-lives are sufficiently long that they could be studied by conventional chemical methods. Some fission barriers along the r-process path were calculated for two sets of liquid-drop-model constants, that differ primarily in their values of the surface-asymmetry constant κ. For $\kappa = 2.84$, which is representative of the values suggested by a variety of new evidence, the potential barrier against fission has practically disappeared for nuclei in the vicinity of mass number 290. The neutron-induced fission of such nuclei should be extremely rapid; thus the r process terminates somewhat before the island of superheavy nuclei is reached. (14 figures, 6 tables, 48 references) (auth)

57714 YIELDS OF SOME PHOTOFISSION PRODUCTS FROM ^{238}U. Schroeder, B.; Nordgren, B.; Alm, A. (Univ. of Lund, Sweden). Nucl. Phys.; A193: No. 2, 555-64(1972).

The yields of some photofission products and of the (γ,n) reaction from ^{238}U were measured in the energy range 100 to 760 MeV. Average cross sections were deduced and compared to calculations. It was found that variations in the average cross sections can be explained by an increasing probability of the formation of highly excited post-cascade nuclides with increasing photon energy. (5 figures, 2 tables) (auth)

57715 STUDY OF THE RADIOACTIVE DECAY LAW. Butt, D. K.; Wilson, A. R. (Birkbeck Coll., London). J. Phys., A (London); 5: No. 8, 1248-51(Aug 1972).

The decay of radon was followed in effect over approximately 40 half-lives in an effort to detect any deviation from the exponential decay law. The results were fitted to a decay of the form $N = N_0 \exp - \lambda t(1 + bt)$ and b was calculated to be $(1.9 \pm 1.0) \times 10^{-6}$ d^{-1}; the half-life was determined to be $3.8235_1 \pm 0.0003_4$ d. (auth)

57716 RELATIVE YIELDS OF XENON ISOTOPES FROM THE NEUTRON FISSION OF ^{249}Pu and ^{233}U. Petrzhak, K. A.; Pan'yan, M. G.; Teplykh, V. F.; Kondrat'ko, M. Ya. At. Energ. (USSR); 33: No. 2, 709-10(Aug 1972). (In Russian).

The relative yields of xenon isotopes resulting from the fission of ^{239}Pu and ^{233}U by thermal neutrons were determined by a mass spectroscope. In the irradiation of ^{239}Pu and ^{233}U targets in a flux of 6×10^{13} n/cm^2·sec and subsequent analysis, allowance was made for neutron capture by ^{135}Xe to form ^{136}Xe, in addition to the ^{136}Xe formed as a fission fragment. Data were obtained for the following four Xe isotopes: 131, 132, 134, and 136. (K.S.W.)

57717 BETA SPECTRUM OF THE FISSION PRODUCTS FROM ^{252}Cf AND THE ASSOCIATED INNER BREMSSTRAHLUNG RADIATION. Heller, R. B.; Sugai, I.; Yuch-li, C.; Chiao, L. W. (George Washington Univ., Washington, D. C.). J. Phys., A (London); 5: No. 8, 1266-71(Aug 1972).

Beta ray intensity against energy in the decay of ^{252}Cf was calculated as a function of time and it is predicted that 7.0 beta rays are emitted per fission. The inner bremsstrahlung radiation from all decaying fragments is shown to be equivalent, in the first 49.96 s after fission, to the radiation from a black body which cools from 1.5×10^{10} to 1.2×10^{10}°K. (auth) (UK)

57718 MEASUREMENTS OF THE FISSION CROSS SECTION RATIO OF ^{238}U TO ^{235}U FROM 2 TO 3 MeV. Poenitz, W. P.; Armani, R. J. (Argonne National Lab., Ill.). J. Nucl. Energy; 26: No. 9, 483-7(Sep 1972).

Measurements of $\sigma_f(^{238}U)/\sigma_f(^{235}U)$ were primarily carried out in the "plateau"-range at 2.5 MeV. Gas scintillation counters and the time-of-flight technique were used. Four different methods were employed for mass assignment. The measured values were slightly higher than those in present use in reactor evaluations. A value of 0.435 ± 0.007 was obtained at 2.5 MeV. (auth)

57719 PHOTOFISSION CROSS SECTIONS OF URANIUM AND THORIUM NEAR THRESHOLD. Mafra, O. Y.; Kuniyoshi, S. (Instituto de Energia Atomica, Sao Paulo, Brazil). An. Acad. Brasil. Cienc.; 43: No. 3-4, 571-4(1971).

Using monochromatic gamma rays from (n,γ) reactions, the photofission cross sections behavior for natural uranium and thorium have been determined in the 5 to 10 MeV energy interval. "Bumps" around the energies of 6.0 MeV and 6.6 MeV for uranium and around 6.7 MeV and 7.6 MeV for thorium have been found. The existence of this structure in the photofission cross section near the threshold is expected by Bohr's prevision about the excitation of rotational states. (auth)

57720 SPLITTING OF THE 5793 keV DOUBLET IN THE ^{225}Ac α-SPECTRUM. Golovkov, N. A.; Dzhelepov, B. S.; Ivanov, R. B.; Mikhailova, M. A.; Chumin, V. G. Yadern. Fiz.; 15: No. 4, 629-30(Apr 1972). (In Russian).

α-transitions intensities of the ^{225}Ac decay to the 36.5 and 38.4 keV levels of ^{221}Fr were measured by an α-spectrograph with a resolution of 1.93 to 2.2 keV. The results are as follows: $I_{\alpha 5793} = 18.1 \pm 2.0\%$, $I_{\alpha 5791} = 8.6 \pm 0.9\%$. With the use of the intensity balance for these levels the transition intensities from the 25.9 keV level are determined: $I_{36.5 \rightarrow 25.9} = 9.6 \pm 5.2\%$, $I_{38.4 \rightarrow 25.9} = 2.3 \pm 2.2\%$. (auth)

Nuclear Theory

Refer also to abstracts 57401, 57485, 57604, 57637, and 57999.

57721 (AD—737364) THEORETICAL NUCLEAR-STRUCTURE STUDIES FOR LIGHT NUCLEI. Final Report. Grillot, David V. (Oregon State Univ., Corvallis. Dept. of Physics). 30 Jan 1972. 12p. (AFOSR-TR—72-393). NTIS.

Three areas of nuclear structure calculations are described for light nuclei. Effective N—N interactions were computed using both the potential and phase-shift method. A doubly self-consistent Hartree—Fock calculation was performed using the computed effective interactions. No significant improvement was obtained for the binding energy per nucleon. The effective Hamiltonian formalism for a truncated space was examined and instabilities in the method were observed. (auth)

57722 (AERE-M—2505) NUCLEAR STRUCTURE ASSOCIATED WITH THE FISSION BARRIER. Lynn, J. E. (Atomic Energy Research Establishment, Harwell (England)). Dec 1971. 41p. Dep. NTIS (U. S. Sales Only). UK 1.00 pounds.

This paper is a survey of the properties of the nuclear states that exist for highly deformed very heavy nuclei. The existence of such states is expected as a result of Strutinsky's theory of nuclear energies as a sum of a liquid drop term and a correction due to single particle effects at the Fermi energy. For the actinide nuclei, according to this, a secondary minimum occurs in the curve describing ground state energy as a function of prolate deformation at a deformation close to the liquid drop fission barrier. This gives rise to the possibility of a sub-set of β-type vibrational states within this secondary well and these are coupled to excitations in the other nuclear degrees of freedom. These highly deformed states constitute a complex family that affects fission reactions in various ways. The lowest states are metastable, decaying very frequently by spontaneous fission. At the high energy end of the spectrum, in the continuum, there exist virtual states that have the property of decaying by neutron evaporation to highly deformed residual nuclei, thus forming spontaneously fissioning isomers. Between these extremes, there exist single states or narrow clusters of states that carry most of the strength of particular β-vibrations. These "vibrational resonances" are recognized by enhanced fissionability. Their experimental investigation gives information on the associated intrinsic excitations, e.g., their single particle character and rotational properties. Highly deformed states of a "compound nucleus" type, which are responsible for narrow intermediate structure in the fission cross-sections of relatively slow neutrons, appear at higher energies, and furnish us with information on barrier heights and statistical level density information on the highly deformed nucleus. (auth)

57723 (COO—2171-6) THEORY OF ANOMALOUS PARITY STATES IN $g_{9/2}$-SHELL NUCLEI. Goswami, A.; McDaniels, D. K., (Oregon Univ., Eugene. Dept. of Physics); Nalcioglu, O. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 1972. Contract AT(11-1)-2171. 12p. (UR—398). Dep. NTIS.

It is shown that the observed features of the anomalous parity states in $g_{9/2}$-shell odd-mass nuclei can be qualitatively explained if core-quasi-particle coupling interactions of the type $-\lambda \underset{\sim}{J}_c \cdot \underset{\sim}{j}_{qp}$ and $-X\underset{\sim}{Q}_c \cdot \underset{\sim}{Q}_{qp}$ are taken into account. (auth)

57724 (COO-2171-10) EFFECTS OF CORE EXCITATIONS IN THE VIOLATION OF THE NUCLEAR PARTICLE-PARTICLE TO PARTICLE-HOLE TRANSFORMATION. Goode, Philip (Rochester Univ., N. Y. Dept. of Physics and Astronomy. Rutgers—The State Univ., New Brunswick, N. J. Dept. of Physics). [nd]. Contract AT(11-1)-2171. 53p. (UR-402). Dep. NTIS.

A core excited shell model for the mass-40 region is developed to account for the discrepancies between particle-particle (pp) and particle-hole (ph) nuclear partners. Explicitly, second order perturbative-type calculations are complete failures when used in an attempt to simultaneously account for the spectral discrepancies between $^{40}K(f_{7/2}^{\nu} - d_{3/2}^{\pi -1})$ and the Racah transform of $^{38}Cl(f_{7/2}^{\nu} - d_{3/2}^{\pi})$ and those between $^{48}Sc(f_{7/2}^{\pi} - f_{7/2}^{\nu -1})$ and the Racah transform of $^{42}Sc(f_{7/2}^{\pi} - f_{7/2}^{\nu})$. However, an (fd)-shell model, which includes core excitations from the $0d_{3/2}$-shell to the $0f_{7/2}$-shell, yields a simultaneous explanation for both sets of spectral discrepancies. The usefulness of the model in the investigation of the positioning of core excited states in ^{40}Ca (like 8p–8h) and in the generation of effective operators is also explored. (auth)

57725 (DEMO-72/6) PAIR DISTRIBUTION FUNCTION AND THE CONDITIONS IMPOSED IN JASTROW METHOD FOR NUCLEAR MATTER. Grypeos, M. E.; Mavrommatis, E. (Democritus Nuclear Research Center, Athens (Greece)). May 1972. 10p. Dep. NTIS (U. S. Sales Only).

The Jastrow method for the calculation of the energy per particle in nuclear matter: E/N is used, in first order of the cluster expansion, by imposing a condition on the correlation function, which arises from the proper normalization of the pair-distribution function. The usefulness of the obtained results is discussed. (auth)

57726 (FRNC-TH-202) METHODS OF SOLVING THE FADDEEV EQUATIONS. Gignoux, Claude (Universite Scientifique et Medicale de Grenoble (France)). 1972. 127p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The exact results given by the Faddeev equations for a simple nuclear reaction model are compared with the results obtained using a simpler approximation method. It is shown that for nucleon exchange or stripping reactions, the classic Born approximation between the deformed waves is better than other methods, but may under certain circumstances lead to erronous estimations. A method of solving the Faddeev equations using realistic potentials is proposed (this problem is important in the study of off-energy shell nucleon—nucleon interactions). This method was used to calculate the binding energy of the triton for several potentials. (auth)

57727 (ITF-72-66-P) BASIS FUNCTIONS OF THE ROTATION GROUP REPRESENTATIONS IN A-I-DIMENSIONAL SPACE AND THE COLLECTIVE MOTION OF ATOMIC NUCLEI. Steshenko, A. I.; Filippov, G. F. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

The collective excitations arising in the framework of the oscillator shell model are investigated. The construction of algorithm to calculate the matrix elements of the potential energy operator of the system in terms of the basis functions of the rotation group representations in A-I-dimensional space is discussed. (auth)

57728 (JINR-P4-6576) INTERACTION OF POLARIZED RESONANCE NEUTRONS WITH ORIENTED NUCLEI. Alfimenkov, V. P.; Efimov, V. N.; Panteleev, Ts. Ts.; Fenin, Yu. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

The total cross sections of interaction of polarized neutrons with random nuclear orientation was studied in an approximation to an isolated resonance level. In the case of p-levels in the presence of two input channels with different spins, the polarized cross sections essentially depend on the ratio of partial neutron widths. The experimental possibility of identifying p-levels is discussed, as well as the determination of their spins and the amplitude ratios of partial neutron widths. (tr-auth)

57729 (JINR-P4-6587) EQUILIBRIUM DEFORMATIONS AND STRUCTURE OF A SERIES OF DEFORMED NUCLEI. Arsen'ev, D. A.; Pashkevich, V. V.; Solov'ev, V. G.; Fainer, U. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

Parameters of equilibrium deformations of even-even and odd deformed nuclei were investigated in the region $174 \leq A \leq 190$. Deviations of the equilibrium deformations of excited states from equilibrium deformations of odd nuclei in their ground state ($\Delta\beta$) were examined. The excitation spectra of a series of odd deformed nuclei were computed, allowing for the effect of $\Delta\beta$. (tr-auth)

57730 (JINR-P4-6590) METHOD OF N. N. BOGOLYUBOV IN THE PROBLEM OF PAIR VIBRATIONS. Dzholos, R. V.; Kartavenko, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

N. N. Bogolyubov's method (1950, 1970) in the theory of strong bonding was used in solving the problem of pair vibrational excitations. The problem was solved in a harmonic approximation. It was demonstrated that the law of conservation of the number of particles was not violated, and spurious solutions were not manifest. (tr-auth)

57731 (JINR-P4-6592) NEUTRON POLARIZATION IN MUON CAPTURE BY COMPLEX NUCLEI. Salganik, Yu. A ; Eramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

The degree of polarization of the neutron from muon capture is investigated by the example of the reaction $\mu^- + {}^4He \rightarrow {}^3H + n + v$. It is shown that both the neutron asymmetry and degree of the polarization are essentially due to the relativistic terms in muon—nucleon Hamiltonian. The effects of the final state interaction between outgoing neutron and the residual nuclei and the short range nucleon—nucleon correlations on the degree of polarization is investigated. (auth)

57732 (JINR-P7-6608) ANALYSIS OF EXCITATION FUNCTIONS IN HEAVY ION REACTIONS. Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 27p. (In Russian). Dep. NTIS (U. S. Sales Only).

The quasi-classical approximation of Ericson and Strutinsky was used in conjunction with the Monte-Carlo method to examine the possible formation of highly-excited complex nuclei with very large angular momenta as a result of heavy-ion reactions. The following reactions were chosen for this analysis of excitation functions: $^{144}Nd(^{12}C, xn)^{156-x}Dy$, $^{136}Ba(^{20}Ne, xn)^{156-x}Dy$, $^{116}Cd(^{40}Ar, xn)^{156-x}Dy$, $^{130}Te(^{12}C, xn)^{142-x}Ce$, $^{130}Te(^{12}C, p6n)^{136}La$, and $^{130}Te(^{12}C, a^{xn})^{138-x}Ba$. (K.S.W.)

57733 (ORNL-tr-2618) INELASTIC INTERACTION OF HIGH ENERGY HELIUM IONS WITH ATOMIC NUCLEI. Barashenkov, V. S.; Gudima, K. K.; Zheregi, F. G.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated for Oak Ridge National Lab., Tenn., from report JINR-P2-6195. 16p. Dep. NTIS.

It is assumed that the inelastic internuclear interaction of an α particle takes place by collision of one intranuclear nucleon with one of the α-particle nucleons. Such collisions are described by means of polynomial approximations. The Fermi motion of the intranuclear nucleon is taken into account as well as the relative momentum of the nucleon within the α particle. This method allows one to describe rather accurately the inelastic α—N interaction in the energy region of up to several tens of GeV. (W.D.M.)

57734 (ORO-4317-12) WAVE-FUNCTION MODELS OF THE TWO-NUCLEON T MATRIX OFF THE ENERGY SHELL. Picker, H. S.; Redish, Edward F.; Stephenson, G. J. Jr. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Jul 1972. 6p. (CONF-720819-12). Dep. NTIS.

From International conference on few particle problems in nuclear interactions; Los Angeles, CA. (28 Aug 1972).

The wave-function model of two-nucleon half off-shell T matrix is extended to include fully off-shell T matrices. The model is compared with the T matrix for the Reid soft-core potential. (J.W.R.)

57735 (RLO-1388-635) MICROSCOPIC THEORY OF NUCLEAR COLLECTIVE MOTION. Haff, P. K.; Wilets, L. (Washington Univ., Seattle. Dept. of Physics). May 1972. 59p. Dep. NTIS.

A generalization of the Hill—Wheeler generator coordinate method is applied to collective deformations. The intrinsic wave function is constrained (as in constrained Hartree—Fock) to be characterized not only by a given deformation, but also by a deformation velocity. This is effected by a simple ansatz which involves operation on the singly constrained wavefunction by an exponentiated single particle deformation operator containing an arbitrary function $\beta(\alpha)$, where α is the collective variable. The expectation value of the energy is minimized with respect to both $\beta(\alpha)$ and the Hill—Wheeler projection function $f(\alpha)$. This leads to an integral equation for f which, upon invoking the collective nature of the intrinsic states, may be approximated by a second order differential equation in the deformation coordinate $\alpha = \langle Q \rangle$. In order to reduce this equation to the Schrodinger form, certain assumptions are introduced with regard to the approximate form of f. This procedure leads to two different differential equations for f and to two mass parameters. One is valid in the classical region and one in the classically inaccessible tunnelling region. This is to be contrasted to the cranking model where sufficient energy must always be available to drive the system. The expressions for the mass parameter are given in terms of expectation values of few-body operators. The case of uniform translation of the nucleus as a whole is studied in detail. The generalized Hill – Wheeler method as described above produces the correct mass (= total nuclear mass). This rigorous reproduction of a known result allows the study of approximations which become necessary for the general case of deformations. (auth)

57736 (UCSD-10-P-11-1) PROBLEMS IN THE THEORY OF MANY-BODY SYSTEMS. Final Report, 1959–1971. Brueckner, Keith A. (California Univ., La Jolla, San Diego). 4 May 1972. Contract AT(11-1)-GEN-10. 66p. Dep. NTIS.

Research in the theory of many-body systems and elementary particles in the period 1959 through 1971 is briefly reported. (J.W.R.)

57737 THREE-BODY RELATIVISTIC KINEMATICS. D'Angelo, S.; de Notaristefani, F.; Monacelli, P. (Univ., Rome). Nucl. Instrum. Methods; 103: No. 2, 197-210(1972).

The directions for use of a program which calculates the relativistic kinematics of a three-body reaction with the target particle at rest in the laboratory frame are given. The program may also be used to study the decay of a particle into three bodies, or the kinematics of a quasi-two-body reaction in which one of the two final particles decays into two particles. The most important kinematic relations involved in a three-body reaction are given. The program allows the calculations of the most frequent physical configurations in terms of many different possible choices for the independent parameters. The possible choices are described. Finally, some examples are given to clarify the compilation of the input deck. (2 figures, 2 tables) (auth)

57738 STRUCTURE OF A SINGLE PARTICLE SPECTRUM AND ENERGY DEPENDENCE OF Γ_f/Γ_n. Ignatyuk, A. V.; Smirenkin, G. N.; Tishin, A. S. (Inst. of Physical Energy, Moscow). Yadern. Fiz.; 15: No. 6, 1124-31(Jun 1972). (In Russian).

The disadvantages are considered of the traditional method of analyzing the energy dependence Γ_f/Γ_n. That is based on the level density of Fermi-gas model. It has been shown, that the shell structure of a single particle spectrum and the nucleon pairing effects have great influence on the course of the fission and neutron widths: taking them into account one can describe the observed behavior of Γ_f/Γ_n at high energies of excitation, as well as close to the fission barrier. (auth)

57739 DOORWAY STATES OF PHONON + PARTICLE TYPE IN (n,γ) REACTIONS WITH N = 28 AND N = 82 NUCLEI. Khat'ko, V. A.; Rudak, Z. A. (Inst. of Physics, Minsk). Yadern. Fiz.; 15: No. 6, 1132-6(Jun 1972). (In Russian).

The role of doorway states of "phonon + particle" type is investigated in (n,γ) reactions with ^{50}Ti, ^{52}Cr, ^{54}Fe, ^{138}Ba, ^{140}Ce, and ^{142}Nd. The calculated intensities for E1-type γ-transitions from the capture state to lower p-levels of ^{51}Ti, ^{53}Cr, ^{55}Fe, ^{139}Ba, ^{141}Ce, and ^{143}Nd are compared with experimental data. (auth)

57740 EXCITATION SPECTRUM OF RESIDUAL NUCLEI IN (π^-,nn) REACTION. Kopaleishvili, T. I.; Machabeli, I. Z.; Chachkhunashvili, M. Sh. (Tbilisi State Univ., USSR). Yadern. Fiz.; 15: No. 6, 1137-41(Jun 1972). (In Russian).

A theoretical study of the excitation spectrum of residual nuclei in (π^-,nn) reactions on ^{16}O, ^{14}N, and ^{12}C has been carried out. The calculations are made in the assumption that π^--mesons are absorbed either from the 1S-orbit or from the 1P-orbit by symmetric nucleon pairs. The dependence of the excitation spectrum on the transferred momentum is investigated. It is shown that 1) the experimental data available may be explained assuming S-absorption; as for the case of P-absorption, the theoretical results are not in accord with these data; 2) even at small momenta transferred the high levels are excited with a relatively high probability. (auth)

57741 SOME FORMULAS FOR INELASTIC SCATTERING CROSS SECTIONS OF NEUTRON. 2. SPIN OF GROUND STATE IS NOT EQUAL TO 0. Ohta, Masao (Kyushu Univ., Fukuoka); Nakagawa, Kiyoshi; Nishihara, Hiroshi. Kyushu Daigaku Kogaku Shuho; 44: No. 6, 717-22(Dec 1971). (In Japanese).

Formulas for inelastic scattering cross sections for neutrons of ^{233}Pa and ^{239}Np were obtained, and the inelastic scattering cross section of the ^{233}Pa was calculated. The cross sections are very important for analysis of burn-up characteristics of fuel. Ground state spins of the ^{233}Pa and ^{239}Np are both different from zero, then, the formulas are more complicated than for spins of zero. Formulas for practical calculation were obtained for 10 cases according to change of spin and parity. By using the formula, the cross sections of ^{233}Pa for inelastic scattering were obtained for energy range of 0.058 ~ 0.086 MeV. The results were shown in a table and a figure. Because the calculation was carried out with real potential and without considering any other processes than the inelastic scattering, the results may be a little incomplete. The results, however, may be useful since there is no measured cross section. (Japan)

57742 EFFECTS OF SHORT-RANGE CORRELATIONS ON THE QUASIELASTIC SCATTERING OF ELECTRONS. Weise, Wolfram (Univ., Erlangen, Ger.). Nucl. Phys.; A193: No. 2, 625-42(1972).

Coincidence cross sections for (e,e′p) reactions are evaluated within the framework of a single-particle model modified by two-particle short-range correlations. It turns out that correlations start to become important in the region of high recoil momenta ($q_R \gtrsim 200$ MeV/c) of the residual nucleus. (9 figures) (auth)

57743 SYMMETRY-CONSERVING THEORIES OF COLLECTIVE MOTIONS. Corbett, J. O. (Oxford Univ.). Nucl. Phys.; A193: No. 2, 401-9(1972).

In a discussion of symmetry-conserving variational theories (projection before variation) it is shown that the conditions for minimizing the expectation value of a nuclear Hamiltonian do not determine an intrinsic single-particle wave function uniquely. This freedom of choice in the intrinsic function allows one to reduce the number of variable parameters in the calculation by attaching arbitrary values (within certain limiting conditions) to some of these parameters. Simplifying assumptions made by some previous writers on the subject are thus shown to be justified. A formal expression is derived for the energy of the lowest state with any given angular momentum, and it is shown that for strongly deformed, heavy nuclei this leads to an expression for the moment of inertia identical with that of Thouless and Valatin when reasonable approximations are made. Both the exact and approximate theories preserve Galileo invariance when applied to linear motion. (auth)

57744 EXTENSIONS TO THE PRE-EQUILIBRIUM STATISTICAL MODEL AND A STUDY OF COMPLEX PARTICLE EMISSION. Cline, C. K. (Univ. of Rochester, N. Y.). Nucl. Phys.; A193: No. 2, 417-37(1972).

Griffin's pre-equilibrium statistical model for nuclear reactions was further extended to take account of the distinguishability between protons and neutrons as well as of the competition of particle emission with particle–hole pair creation and destruction. In addition, an empirical factor equal to the factorial of the mass number of the emitted particle was introduced into the rate expressions for particle emission. In this extended form, the model was used to analyze the spectra of protons, deuterons, tritons, and ^{3}He and ^{4}He ions emitted in proton-induced reactions. For each reaction system, the model parameters were varied to reproduce the proton spectrum, and the spectra for the remaining four particle types were calculated with no added adjustable parameters. For systems lighter than gold, the relative charged-particle yields are well reproduced by the model, while for ^{197}Au and ^{209}Bi too few tritons are predicted. The spectral shapes for the complex particles are approximately reproduced at bombarding energies around 30 MeV, but for higher energies the data show more high-energy tritons and ^{3}He and ^{4}He ions than can be accounted for with the model. It is thought that these high-energy particles may be produced in direct two- and three-nucleon pickup processes, which are not included in the model. The initial exciton numbers obtained from the analysis appear to be consistent with earlier values if strong collective excitations are removed from the proton spectra. The fraction of pre-equilibrium emission is found to increase with increasing bombarding energy. (7 figures, 4 tables, 40 references) (auth)

57745 ELASTIC ELECTRON SCATTERING BY ^{16}O WITH SHORT-RANGE CORRELATIONS: STUDY OF THIRD-ORDER TERMS. Guardiola, R.; Oset, E. (Univ. of Barcelona). Lett. Nuovo Cim.; 4: No. 16, 869-73(19 Aug 1972).

The charge form factor for electron elastic scattering by ^{16}O was calculated through third-order terms using the Aviles – Hartog – Tolhoek cluster expansion. The results are compared with similar calculations for ^{4}He. (J.W.R.)

57746 CONSISTENT SYMMETRIES IN A RIGOROUS APPROACH TO THE HARTREE–FOCK PROBLEM. Catara, F.; Di Toro, M.; Lombardo, U. (Univ., Catania). Lett. Nuovo Cim.; 4: No. 16, 849-52(19 Aug 1972).

The consistent symmetry criterion in the solution of the nuclear Hartree – Fock problem by the Newton – Kantorovic iterative procedure is analyzed. (J.W.R.)

57747 OPTICAL ANISOTROPY OF ATOMIC NUCLEI. Semenko, S. F. Tr. Fiz. Inst., Akad. Nauk SSSR; 54: 149-207(1971). (In Russian).

Optical anisotropy, a tensor character of the polarizability of nuclei, is manifest in photonuclear reactions in the region of the giant dipole resonance. The kinematics of the interaction of radiation with an optically anisotropic system were investigated, and attempts to determine the parameters of the latter are discussed. Microscopic models (different variants in the approximation of ''particle–hole'') were used to estimate parameters of optical anisotropy of strongly deformed, axially symmetric nuclei. A statistical model of dipole and quadrupole vibrations was constructed and used to evaluate the effects of optical anisotropy caused by different types of nuclear deformation. (tr-auth)

57748 CALCULATIONS OF STATIC QUADRUPOLE MOMENTS AND ANHARMONICITY PARAMETERS OF EVEN TIN AND TELLURIUM ISOTOPES. Marshalek, E. R. (Technische Univ., Munich. Theoretische Physik, Garching, Ger.). Lett. Nuovo Cim.; 4: No. 13, 631-6(29 Jul 1972).

Static quadrupole moments and the magnitudes of anharmonic energy corrections were calculated for even Sn and Te isotopes using the pairing plus quadrupole–quadrupole model. The RPA was taken as the zeroth order and anharmonicities were treated as small perturbations. The results are compared with other calculations. (J.W.R.)

57749 DERIVATION OF A CORRECTION TO THE NUCLEAR OPTICAL MODEL POTENTIAL DEPTH FOR A SPIN-DEPENDENT NUCLEON–NUCLEON INTERACTION. Lewis, Murrell Elroy. Columbus, Ohio; Ohio State Univ. (1972). 76p. University Microfilms Order No. 72-20,981.

Thesis.

A correction term which is proportional to the derivative of the off-energy-shell scattering amplitude, evaluated on-energy-shell, is expressed as a partial wave expansion involving certain ''phase shifts'' for a spin-independent interaction. Analytic expressions for the ''phase shifts'' are obtained and the method applied to the special case of a square well potential and orbital angular momentum $l = 0$. Finally, the results for a general (well-behaved) spin-dependent nucleon–nucleon interaction are obtained in a form applicable to nucleon–nucleus scattering from an even–even, $J,T = 0$ nucleus. (Diss. Abstr. Int., B)

57750 MECHANISM OF (n,p) AND (n,α) REACTIONS ON LIGHT AND MIDDLE NUCLEI. Savel'ev, A. E.; Aver'yanov, I. K.; Dzyuba, B. M. Yadern. Fiz.; 15: No. 4, 744-8(Apr 1972). (In Russian).

Calculations have been carried out for the total cross sections of neutron-nucleus interactions with proton and α-particle production on the basis of the Hauser–Feshbach method. The main mechanism of nuclear (n,p) and (n,α) reactions is shown to be a process of a production and a decay of the compound nucleus at initial neutron energy up to ~20 MeV for target nucleus mass numbers in the region $24 \leq S \leq 64$. (auth)

57751 POSSIBILITIES OF A HIGH EXCITED STATE (RESONANCE) STRUCTURE EXAMINATION WITH NEUTRON SPECTROSCOPY METHODS. Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 4, 733-43 (Apr 1972). (In Russian).

A question is considered on high excited state (resonance) characteristics which must be known to clarify their structure. The possibilities of the time-of-flight techniques in neutron spectroscopy for the high excited state structure examination are shown to be extended considerably if one would use unstable nuclei and isomers as the targets. A qualitative explanation of the state density increasing with an increasing of excitation energy and of the mass number dependence of the density is given. On the basis of data on reduced s-neutron capture widths and E1-transitions to low lying states estimations were made of a small-quasiparticle component contribution to the high excited state wave functions. The question was examined on correlations between the reduced neutron and radiative widths and the cases were pointed out when large correlations may be expected. The question is considered on the correlations between (n,γ)- and (d,p)-reactions. (auth)

57752 SCATTERING OF HIGH-ENERGY ELECTRONS BY ^{3}H AND ^{3}He NUCLEI. Sitenko, A. G.; Kozlovskii, I. V.; Tartakovskii, V. K. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 15: No. 4, 725-32(Apr 1972). (In Russian).

General formulas for inelastic electron form factors of ^{3}H and ^{3}He nuclei as functions of momentum transfer have been obtained. The calculations were performed using the Gaussian wave function for the ground state, the wave function parameters being derived from the elastic electron scattering data. The inelastic scattering cross sections calculated with these parameters are in agreement with available experimental data. The consideration of mixed symmetry states, as well as of the nuclear current is shown to be essential for the inelastic scattering case. (auth)

57753 NUCLEAR DENSITIES IN THE K-HARMONIC METHOD. Levich, A. P. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 15: No. 4, 721-4(Apr 1972). (In Russian).

The results of nuclear densities calculations with a method of the nuclear wave function decomposition on the harmonic polynomials in the $K = K_{min}$ approximation are compared with the experimental data. The calculated physical values depending on the nuclear densities differ in average by a 5–8% from the data obtained with magic Ca, Sn and Pb nuclei in experiments on the nuclear form determination with electromagnetic methods. (auth)

57754 MATRIX ELEMENTS FOR THREE NUCLEON SYSTEM IN K-HARMONIC METHOD. Pustovalov, V. V. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 15: No. 4, 710-20(Apr 1972). (In Russian).

Reduced matrix elements in the Euler angle space are calculated for central, tensor, linear and quadratic spin-orbit forces as well as for forces being proportional to the orbital momentum squared. Harmonic polynomials with K^2, L^2, M, ν, Ω quantum numbers and definite rearrangement symmetry are the initial functions. The matrix elements are integrals on the internal variables. (auth)

57755 E2-TRANSITION PROBABILITIES IN A RIGID ASYMMETRIC ROTATOR MODEL. Gai, E. V.; Rabotnov, N. S. Yadern. Fiz.; 15: No. 4, 705-9(Apr 1972). (In Russian).

A ratio of reduced probabilities of E2-transitions from anomalous rotator band 2+ level to a first 2+ level and the ground state is calculated in a rigid asymmetric rotator model. An assumption of a connection of the spherical inertia tensors with the quadrupole top moments is used which permits not to introduce additional parameters. Results obtained are compared with experimental data on even-even nuclei. (auth)

57756 DAVYDOV–CHABAN MODEL ANALOG. Fedorov, A. D. (Khabarovsk Polytechnical Inst., USSR). Yadern. Fiz.; 15: No. 4, 699-704(Apr 1972). (In Russian).

To solve the Schroedinger equation with a Hamiltonian which takes into account the kinetic energy dependence on deformation β an assumption of smallness of deformation from an equilibrium position is used. It permits one to replace the mass functions $F_1(\beta,\gamma)$ and $\Phi_k(\beta,\gamma)$ with their values at $\beta = \beta_0$ and to use the Davydov–Chaban approximation. (auth)

57757 COLLECTIVE 0^+ AND 2^+ STATES IN DEFORMED NUCLEI. Rumyantsev, B. A.; Telitsyn, V. B. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz.; 15: No. 4, 690-8(Apr 1972). (In Russian).

Results of numeral calculations are given for properties of $J^\pi = 0^+$ and 2^+ collective states. The taking into account the gauge invariant interaction in the particle-particle channel leads to the appearance of new collective branches with energies lower than the two-quasiparticle threshold energy and improves considerably the consistency between theory and experiment. (auth)

57758 E1- AND E2-TRANSITIONS IN MIDDLE AND HEAVY SPHERICAL NUCLEI. Kamerdzhiev, S. P. Yadern. Fiz.; 15: No. 4, 676-89(Apr 1972). (In Russian).

The 1^- level energies in the 0–30 MeV interval, reduced ground to excited state E1-transitions probabilities, γ-ray capture cross sections and integral cross sections are calculated with a finite Fermi systems theory method for ^{112}Sn, ^{120}Sn, ^{124}Sn and ^{208}Pb. The same characteristics of 2^+ levels and E2-transitions are calculated for ^{120}Sn and ^{208}Pb. Influence of a pairing and spin-spin forces on characteristics of the giant resonance is examined. Properties of the giant E2-resonance and ''pigmi-quadrupole'' one are calculated and compared. The calculated $B(E2, 0^+ \rightarrow 2^+)$ values and the first 2^+ level energies in ^{120}Sn and ^{208}Pb are found to agree with experimental data without an introduction of an effective quadrupole charge and with using the same set of the theory constants taken from the other nuclei properties calculations. Except for the giant E2-resonance region an appreciable quadrupole absorption should be observed in the 9.5–11.5 MeV energy region. The integral cross section for ''pigmi-resonance'' is estimated. (auth)

57759 PAIRING VIBRATIONS IN THE THEORY OF FINITE FERMI SYSTEMS. Landi, G.; Matera, F. (Univ., Florence). pp 207-9 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

57760 SHELL MODEL APPROACH TO THE $f_{7/2}$ -SHELL. Talmi, I. (Weizmann Inst. of Science, Rehovot, Israel). pp 511-18 of Structure of $1f_{7/2}$ Nuclei. /Ricci, R. A. (ed.). Bologna; Editrice Compositori (1971).

From Conference on the structure of $1f_{7/2}$ nuclei; Padua, Italy (15 Apr 1971). See CONF-710447.

PHYSICS (PLASMA AND THERMONUCLEAR)

Confinement and Heating

57761 (AEC-tr-7320) CONDITIONS OF PLASMA HEATING AT ELECTRON CYCLOTRON RESONANCE. Vinogradov, N. I.; Podushnikova, K. A.; Poloshkin, B. P. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). Translation of report NP-18635. 8p. Dep. NTIS.

Conditions for the formation of a group of high-speed particles and the dynamics of heating of this group and of the basic electronic component of the plasma in electron cyclotron heating were researched. It was found that the heating efficiency of the basic component and the group of high-speed electrons depends on the spatial position of the resonance sphere. The heating rate of the basic group ~10^8 eV/sec, and that of the high-speed particles ~7×10^9 eV/sec. Evaluations are made that demonstrate that heating of the basic component could occur outside the resonance sphere, but that the high-speed particles are heated within the resonance sphere. (auth)

57762 (AEC-tr-7327) MEASUREMENT OF THE TRANSVERSE DIFFUSION COEFFICIENT IN SHF PLASMA. Bulyginskii, D. G.; Vil'dzhyunas, M. I.; Poloskin, B. P.; Utochkin, B. A. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). Translation of report NP-18917. 11p. Dep. NTIS.

Plasma created in a straight mirror trap of the following parameters is discussed: length $l = 100$ cm, diameter $d = 12.6$ cm, mirror ratio ~2, magnetic field in the center of system $H = 2$ to 3.5 kG, microwave power 30 W, frequency ~8.8 GHz, half-period of the field H of 160 msec, and hydrogen pressure from 4×10^{-5} to 2×10^{-3} torr. The characteristics of the plasma generated by electron cyclotron resonance were: $T_e = 3$ to 8 eV, $T_i = 1$ eV, and $n_e = 1$ to 3×10^{10} cm^{-3}. Measurements were made of the normal diffusion coefficient $D_\perp$ due to azimuthal fluctuating electric fields E_φ versus H and P, using the formula $D_\perp = (c^2 E_\varphi^2 / H^2) \int_{-\infty}^{\infty} \Psi_E(\tau) d\tau$ where $\Psi_E(\tau)$ is the normalized autocorrelation function of E_φ. The results presented show that $D_\perp$ is close to the Bohm diffusion at high pressure. This was confirmed by probe measurements treated according to Bertotti's theory. But at lower pressure, when the electron mean free path becomes comparable to the trap dimension, a sharp rise of $\overline{E_\varphi^2}$ is observed. The latter may be accounted for by the appearance of a group of fast electrons accelerated by the resonance wave. The experimentally observed anomalous diffusion is considered as being due to the low-frequency broad spectrum turbulence, which develops from the drift waves near the plasma surface. (auth)

57763 (EUR-CEA-FC-601(Rev.1)) NEOCLASSICAL THEORY OF MAGNETIC PUMPING (T.T.M.P.) IN TOROIDAL GEOMETRY: TABLES OF RESULTS. Canobbio, E.; Giuffre, S. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). May 1972. 38p. Dep. NTIS (U. S. Sales Only).

Detailed results of the neoclassical theory of transit time magnetic pumping in toroidal geometry are presented. They are important for the practical purpose of assessing the feasibility of T.T.M.P. heating in a given experimental situation. The critical density separating the nonlinear heating region from the linear region is compared with the critical density separating the banana from the plateau region in neoclassical toroidal diffusion. (France)

57764 (EUR-CEA-FC-628-AG) REPORT OF THE EURATOM CONTROLLED FUSION ADVISORY GROUP ON OPEN ADIABATIC CONFIGURATIONS AND RADIO FREQUENCY PLUGGING. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec 1971. 119p. Dep. NTIS (U. S. Sales Only).

The current state of research in western Europe on mirror devices (only open-type adiabatic devices being considered) is presented. The scientific basis to the widespread pessimistic outlook in this field of research is discussed, together with the conclusions that can be drawn. The problems discussed include: magnetohydrodynamic stability and magnetic wells; recycling and dynamic stabilization; losses due to collisions, microinstabilities and radiation; multiple mirrors; hybrid collisionless systems, adiabatic and nonadiabatic radiofrequency plugging; external and internal re-injection schemes. Problems concerning the fuel cycle and reactor systems not based on the DT reaction are also presented. (France)

57765 (IPP-IV-37) LOWER-HYBRID-RESONANCE HEATING OF A PLASMA IN A PARALLEL-PLATE WAVEGUIDE. Puri, S.; Tutter, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Jun 1972. 37p. Dep. NTIS (U. S. Sales Only).

Wave propagation in a parallel-plate metallic waveguide partially filled with an inhomogeneous, anisotropic plasma column is studied as an eigenvalue problem using the complete cold-plasma dielectric tensor. Although the accessibility condition is not met, the collisional energy absorption at the lower-hybrid resonance greatly exceeds the resistive loss at the waveguide walls resulting in a very high plasma heating efficiency. The bulk of the wave energy dissipated goes into heating the electrons. The heating continues to be effective even for very low collision frequencies encountered in thermonuclear plasmas. Detailed numerical results for the heating efficiency, energy flux into the plasma, energy density, and dissipation density in the plasma column as well as group velocity are presented. Also, the effects of density profile, collision frequency, and waveguide eigenmodes are discussed. (auth)

57766 (ORO-3871-7) ION RESONANCE HEATING STUDIES. Progress Report. Swanson, D. G. (Texas Univ., Austin. Plasma Research Lab.). 15 Sep 1972. Contract AT(40-1)-3871. 27p. Dep. NTIS.

The results of several different high-power rf-heating experiments on the THM-2 mirror device are discussed. The first experiment discussed used a capacitor and a spark-gap arrangement to provide a fast-rising high-power rf source designed to study heating on time scales too short for plasma energy-loss mechanisms to dominate. The second group of experiments discussed used a 1-MW hf transmitter system to provide hf power and an inductive antenna to couple the energy to the plasma. The third experiment discussed involves the use of a capacitive antenna coupling structure for coupling the rf to the plasma. The transmitter system is described in an appendix. (M.O.W.)

57767 NEOCLASSICAL DIFFUSION OF A FINITE-β, TOKAMAK PLASMA. Nocentini, A. (Univ., Trieste, Italy). J. Plasma Phys.; 7: No. 3, 427-34(Jun 1972).

The neoclassical diffusion in a tokamak is calculated for a finite-β plasma. The flux of the particles is shown to be substantially unchanged, with respect to the low-β case. The "equilibrium" equation is derived; from it, the magnetic surfaces can be obtained once the external electromagnetic field and the density and temperature profiles are given. The case of magnetic surfaces with circular cross section, in the small-aspect-ratio limit, is considered in detail. (auth)

57768 STATIONARY EQUILIBRIUM AND DIFFUSION IN A TOROIDAL PLASMA WITH HELICAL MAGNETIC FIELD. Terashima, Yoshinosuke; Miyamoto, Kenro (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 33: No. 4, 1132-41(Oct 1972).

A theoretical study of the equilibrium and diffusion in a stellarator field with the helical winding $l = 3$ is carried out. It is shown that a stationary equilibrium exists even when finite-inertia and finite-ion-gyroradius effects are taken into account. The plasma loss flux consists of two parts: one is determined by the averaged magnetic field, and the other is due to the perturbed components with helical structure of the electrostatic potential and of the density distribution. The latter term will become appreciable when a marked anisotropy in electron pressure occurs. (auth)

57769 DEVICE FOR HEATING UNINTERRUPTED PLASMA. de Ruiter, J. W. (to N. V. Philips' Gloeilampenfabrieken). Canadian Patent 890,614. 11 Jan 1972. Priority date 2 Sep 1968, Netherlands.

A device is described for inductively heating a plasma in a closed annular space by means of a high-frequency current. The discharge current of a capacitor in the form of electric pulses inductively supplies electric energy to the plasma produced by the high-frequency current. The connection of the capacitor for giving off the accumulated energy is such that feedback with the high-frequency generator is avoided. (Canada)

57770 PLASMA CONFINED IN THE MINIMUM B INDUCED BY SINGLE-LOOP CURRENT. Murata, Toshio; Negishi, Riichiro; Saito, Morimasa; Nanri, Kenzo; Tsuruoka, Yasuhiko (Tokai Univ.). Proc. Fac. Sci. Tokai Univ.; 6: No. 1-2, 47-55 (Mar 1971).

A minimum B in a magnetic field is one of the useful methods for confinement of plasma. In this experiment, the field of the minimum B is induced by a current flowing through the "tennis ball seam" type coil. The plasma is produced in a high-frequency discharge at pressure of 5×10^{-2} mmHg in air. The applied hf field is 250 V in height, peak to peak, at 14.5 MHz in frequency and at 65 mA in current. The spatial distribution of plasma density and temperature are measured by a double-probe method with increasing the coil current. It was found that the plasma density and temperature is slightly increased with increasing magnetic fields. (auth) (Japan)

57771 CONFINEMENT OF PLASMA BY MEANS OF T.B.S. TYPE MAGNETIC FIELD. Abe, Yoshiaki; Ito, Takao; Saito, Morimasa; Negishi, Riichiro; Nanri, Kenzo (Tokai Univ.). Proc. Fac. Sci. Tokai Univ.; 7: No. 1-2, 23-8(Feb 1972).

The decay times of plasma density were studied in the minimum-B T.B.S (Tennis Ball Seam) type magnetic field. The plasma, which is generated by a Marshall-type coaxial plasma gun, having density $n = 10^{13}$ to 10^{15} cm^{-3} and velocity $\nu = 10^5$ to 10^6 cm/sec is injected along a mirror axis of the T.B.S. field. The dependence of the decay times of the density on a magnitude of the magnetic field strength and on an applied voltage of the plasma gun were determined by a double probe method. The results show that the decay times of the density increased with increasing field strength. In the strongest field, the maximum 1/e-folding time of the density is 85 μsec. (auth) (Japan)

57772 DEPENDENCE FOR LOSS CONE ON ACCELERATING POTENTIALS AND INJECTION ANGLES OF ELECTRONS IN MAGNETIC MIRROR FIELDS. Nanri, Kenzo (Tokai Univ.). Proc. Fac. Sci. Tokai Univ.; 6: No. 1-2, 57-64(Mar 1971).

The electrons, continuously injected into the magnetic mirror field and escaping along the magnetic field lines are studied by varying the following parameters: (1) mirror ratio of the magnetic mirror field from the value of 3.7 to 7.2; (2) accelerating potential of the electrons from the value of 1.5 kV to 2.5 kV; and (3) injection angle of the electrons from the value of 20° to 120°. In spite of changing the accelerating potentials and the injection angles, the ratio of escaping electrons to injected electrons along the magnetic field lines was constant and there was no dependence on the mirror ratio, which determines a loss cone in the velocity space. (auth) (Japan)

57773 TRANSIT TIME HEATING IN STOCHASTIC ELECTROMAGNETIC FIELDS. Nakach, R. (CEN, Grenoble, France). Plasma Phys.: 14: No. 9, 849-55(Sep 1972).

By using a "test particle" approach, the transit-time heating of the ions of a plasma subject to the influence of randomly time-varying electromagnetic fields is studied. The heating rate is given and it is shown that, for field-shape and energy-spectrum distribution adequately chosen, the ion-temperature increases linearly with time. The particle distribution function remains maxwellian in the course of time if it is so at the initial time, independent of the plasma density. (auth)

Diagnostics

Refer also to abstracts 57118 and 57811.

57774 (AEC-tr-7324) PROBE METHOD FOR RECORDING IONS PRODUCED BY LASER RADIATION IN AFTERGLOW DISCHARGE PLASMA. Bakov, I.; Kantor, I.; Kim, A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translation of report NP-18765. 8p. Dep. NTIS.

A probe method was developed for recording ions produced by laser emission, permitting highly accurate compensation of the ion background in the discharge and recording probing current change of the order of 10^{-9} amp in a time of the order of 10^{-6} sec. (auth)

57775 (EUR-CEA-FC-641) MULTICHANNEL DIGITAL SPECTROMETER. Clement, M.; Stevenin, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Apr 1972. 46p. (In French). Dep. NTIS (U. S. Sales Only).

This multichannel digital spectrometer for measuring the ion temperature of the Circe 25-kW device utilizes the Doppler broadening effect undergone by the 4686A He$^+$ line. The extreme sensitivity required (due to the low luminosity of the plasma) led to the choice of a flexible digital electronics system (easily synchronized, capable of dealing with variable exposure times, and having a computerized output) for the acquisition of data and the output of results, and a Fabry–Perot interferometer system having 12 spectral channels. (France)

57776 (FRNC-TH-216) PRODUCTION AND DETECTION OF RADIATION IN THE HOLWECK ENERGY BAND: APPLICATIONS TO PLASMA-LASER SPECTROSCOPY AND PHOTOIONIZATION OF Bi. Dhez, Pierre (Paris Univ., Orsay (France)). 1971. 134p. (In French). Dep. NTIS (U. S. Sales Only). Thesis.

Improvements were made in experimental techniques applicable in the Holweck energy band (1000 to a few dozen A). A laser-produced plasma was used as a radiation source. A detector was developed suitable for accurately measuring the flux emitted by fast pulsed sources. The separation of the different orders of interference was studied using a P. Jaegle double-grating spectrograph to examine the spectral continuum. New emission properties exhibited by the plasma, which result from the focusing of the laser beam by the plasma, were established. In this way, accurate results on the photoionization of Bi in an extended wavelength band were obtained. This photoionization cross section was measured between 250 and 40 eV using a double-grating spectrograph. (France)

57777 (IAE-2120) INDUCTION COIL OF FINITE LENGTH FOR ABSOLUTE MEASUREMENTS OF THE ELECTROCONDUCTIVITY OF MEDIA. Kuleshov, V. P.; Medvedev, Yu. V. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 24p. (In Russian). Dep. NTIS (U. S. Sales Only).

Formulas were derived and calculated for the measurement of the impedance of single-layer induction coils of finite length as a function of their dimension, diameter of the conducting cylinder 2α, and parameter $S = \mu\mu^{\circ}\omega\sigma\alpha^2$. Experimental results agree well with the calculated results, which indicates the possibility of the absolute measurement of the electric conductivity with direct transducers by the method of eddy currents. (tr-auth)

57778 MICROWAVE MEASUREMENT OF ELECTRON DENSITY IN A PLASMA COLUMN CONTAINED IN A DIELECTRIC TUBE. Hooper, G. (University Coll. of Wales, Aberystwyth, Eng.). J. Phys., D (London); 5: No. 6, L47-51(Jun 1972).

The performance of microwave cavities loaded with a concentric plasma column is discussed, with particular reference to those modes of oscillation which exhibit a field minimum on the cavity axis. The effect of the plasma containing tube is considered, and it is noted that in the case of the TE$_{011}$ mode, a dielectric-containing tube causes an enhanced shift in resonant frequency for a given electron density. (auth)

57779 APPRAISAL OF THE SINGLE LANGMUIR PROBE TECHNIQUE IN THE STUDY OF AFTERGLOW PLASMAS. Smith, D.; Plumb, I. C. (Univ. of Birmingham, Eng.). J. Phys., D (London); 5: No. 7, 1226-38(Jul 1972).

A detailed appraisal of the collisionless sheath single cylindrical Langmuir probe technique applied to the study of electron densities and temperatures in afterglow plasmas is described. It is shown that for positive probe potentials (V) no significant disturbance ("pseudodepletion") of the plasma occurs until the electron current to the probe (i_e) approaches the natural diffusive positive ion current flowing to the reference electrodes. This is indicated by departures from linearity of $i_e^2 - V$ plots obtained in the orbital-limited current regime. Departures from linearity were also observed due to probe sheath expansion resulting in departures from cylindrical geometry above a critical value of V. It is shown that, for values of V below those critical values signifying the onset of pseudodepletion and sheath expansion, meaningful probe characteristics can be obtained in afterglows from which accurate electron densities can be obtained. Also described are the effects which arise from temporal changes of electron temperature, and the resulting changes in floating potential V_f. The latter has been measured as a function of the electron temperature (obtained from plots of the electron retarding region) and is shown to substantiate the original Langmuir theoretical expression for V_f. (auth)

57780 COMMENTS ON THE USE OF THE ESCAPE FACTOR IN PLASMA SPECTROSCOPY. Biaz, T.; Pham, D. W. J. Phys., B (London); 5: No. 5, L98-100(May 1972).

The use of escape factors to compute atomic number densities of optically thick nonthermal plasma is given a basis of plausibility by examining carefully the validity conditions of Biberman's approximate solution of Holstein–Biberman's integral equation. (auth)

57781 STUDY OF TRANSIENT PHENOMENA USING A TEA–CO$_2$ LASER AND A LIQUID CRYSTAL DETECTOR. Hugenschmidt, Manfred; Vollrath, Karl (Institut Franco-Allemand de Recherches, Saint-Louis, France). Compt. Rend., Ser. B; 274: No. 22, 1221-4(29 May 1972). (In French).

Ultra-fast phenomena may be analyzed using a pulsed CO$_2$ laser in conjunction with various optical techniques. The transformation of the infrared image into a visible image is accomplished with liquid-crystal layers. The spatial resolution obtained is in good agreement with the numerical results calculated using a computer. (France)

57782 OPTICAL MEASUREMENTS OF THE DEGREE OF TURBULENCE OF A GUN PLASMA. Matt, Detlef Rainer. Knoxville, Tenn.; Univ. of Tennessee (1972). 73p. University Microfilms Order No. 72-21,359. Thesis.

Turbulent electric fields of the order of 7 kV/cm were observed in a plasma from a gun. These values were obtained by measuring the ratio of the forbidden companions of the He I 4471- and 4921-Å lines to their corresponding allowed transitions. The electric fields were also observed by examining the shape of the He II 4686 Å and the red wind of the He I 4471-Å lines. The measured plasma charge density of $7 \times 10^{12}/\text{cm}^3$ was too low to account for the broadening. The plasma turbulence was determined to be 3% of the electron thermal energy. The observed damping was compatible with spatial linear Landau damping for a mean wavelength 30 times the Debye wavelength. (Diss. Abstr. Int., B)

57783 LECHER WIRE MICROWAVE INTERFEROMETER FOR MEASUREMENTS OF ELECTRON DENSITY AND ELECTRON TEMPERATURE IN A FLOWING TRANSIENT PLASMA. Cheung, A. Y.; Koopman, David W. (Univ. of Maryland, College Park). Rev. Sci. Instrum.; 43: No. 10, 1444-50(Oct 1972).

A microwave diagnostic system for measurement of electron density and temperature in a transient plasma flow, generated by a laser pulse focused on a solid target, was constructed using a twin conductor (Lecher wire) probing element coupled to X-band waveguide components by tapered parallel planes. The analysis of the operation of the probing section has required the solution of a symmetric seven layer dielectric problem, which models the transmission, reflection, and attenuation of the microwave signal by plasma located around Lecher wires. Simultaneous measurements of the phase and amplitude of the transmitted signal, together with an experimental configuration which accurately defines the interaction of the plasma with the Lecher wire section, have made possible the reliable determination of plasma properties with a spatial resolution of ~0.5 cm and a temporal resolution of $\sim 5 \times 10^{-8}$ sec. (auth)

57784 ELECTROSTRATIC PROBES IN A FLUX OF CHARGED PARTICLES. Fitaire, M.; Pointu, A. M. (Univ. Paris-Sud, Orsay, France). Phys. Lett.; 41A: No. 4, 355-6(9 Oct 1972).

A method is presented for plasma diagnostics that uses a low-frequency modulated floating double probe. This method can be applied to plasmas created by intense fluxes of charged particles. (auth)

57785 SPECTROSCOPIC MEASUREMENTS FOR ATMOSPHERIC NITROGEN AND HELIUM ARCS. Incropera, F. P.; Murrer, E. S. (Purdue Univ., Lafayette, Ind.). J. Quant. Spectrosc. Radiative Transfer; 12: No. 10, 1369-77(Oct 1972).

Thermal conditions in the asymptotic region of atmospheric nitrogen and helium arcs are determined spectroscopically and calculated using an equilibrium flow model. The equilibrium model is shown to be ill-suited for both gases. The helium arc is characterized by a high degree of thermochemical nonequilibrium, and significant thermochemical and excitation nonequilibrium effects characterize the nitrogen arc. (auth)

57786 EFFECT OF IONIZATION ON HEAT TRANSFER TO WIRES IMMERSED IN A HIGHLY THERMALLY-IONIZED PLASMA. Petrie, T. W. (Univ. of Illinois, Urbana); Pfender, E. Waerme Stoffuebertrag.; 5: No. 2, 85-100(1972).

Results obtained with a previously developed technique for measuring local heat transfer to bare and ceramic coated metal wires from a dense, highly thermally-ionized plasma are presented and compared with theoretical predictions. A free-burning arc in argon at atmospheric pressure provides a plasma in local thermodynamic equilibrium. Wire probes are swept through this plasma in planes parallel to the anode. The wires do not draw a net current from the plasma. Experimental evidence indicates that the layer between the undisturbed plasma and the probe surface is not in chemical equilibrium. The data show that heat transfer to the wire in this situation is dominated by the energy transport associated with electron and ion partial currents to the probe surface as determined by the potential of the probe with respect to the plasma. The data obtained using this technique provide an experimentally verified model for the heat transfer to wires immersed in a plasma over a wide range of plasma conditions including a 100% variation in the degree of ionization. (auth)

57787 SPHERICAL LANGMUIR PROBE: COMPLEMENTS TO THE CLASSICAL THEORY. Virmont, J.; Godard, R. (Ecole Polytechnique, Paris). Plasma Phys.; 14: No. 8, 793-803 (Aug 1972).

The classical model of a perfectly absorbing spherical probe in a maxwellian plasma at rest, without collisions or magnetic field, is considered. It is shown that it is possible to obtain, from the saturation branches of the probe characteristic both a precise value of the plasma density and an order of magnitude estimate for the ion temperature. (auth)

Kinetics (General)

Refer also to abstracts 57087 and 57147.

57788 EFFECT OF A LONGITUDINAL MAGNETIC FIELD ON THE PARAMETERS OF THE REACTIVE OSCILLATIONS IN A GAS DISCHARGE. Zakharenko, Yu. G.; Privalov, V. E. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 16: No. 12, 2130-2(Dec 1971).

Translated from Radiotekh. Elektron.; 16: No. 12, 2323-5(Dec 1971).

A hot-cathode discharge along the axis of a solenoid was studied. With an increase in the longitudinal magnetic field intensity, the slope of the I—V characteristic was reduced and the region in which the reactive oscillations exist was shifted toward lower currents. Diagrams of the I—V characteristics are shown. (M.O.W.)

57789 EXPERIMENTAL EVIDENCE FOR SUPERSONIC ION FLOW IN A LOW PRESSURE PLASMA. Varey, R. H.; Kapp, L. B. (Central Electricity Generating Board, Southampton, Eng.). J. Phys., A (London) 5: No. 7, 1119-23(Jul 1972).

An experiment is described in which plane Langmuir probes with different orientations with respect to ion flow were used to measure ion velocity in the side arm of a low-pressure mercury discharge. The ions appear to be supersonic, a result that confirms recent theoretical predictions. (auth)

57790 STARK PROFILES OF FORBIDDEN AND ALLOWED TRANSITIONS IN A DENSE, LASER PRODUCED HELIUM PLASMA. Ya'akobi, B.; George, E. V.; Bekefi, G.; Hawryluk, R. J. (Univ. of Maryland, College Park). J. Phys., B (London); 5: No. 5, 1017-30(May 1972).

Comparisons of experimental and theoretical Stark profiles of the allowed 2^1P-3^1D helium line at 6678 Å and of the forbidden 2^1P-3^1P component at 6632 Å in a dense plasma were carried out. The plasma was produced by optical breakdown of helium by means of a repetitive, high-power CO_2 laser. The allowed line shows good agreement with conventional theory, but discrepancies are found around the center of the forbidden component. When normally neglected ion motions are taken into consideration, the observed discrepancies are partially removed. Tables of the Stark profiles for the pair of lines are given for electron densities in the range 3×10^{15} to 3×10^{17} cm^{-3} and temperatures in the range 10,000 to 40,000°K. (auth)

57791 ELECTRICAL RESISTIVITY OF NEON PLASMA IN A TOKAMAK. Hinnov, E.; Johnson, L. C.; Meservey, E. B.; Dimock, D. L. (Princeton Univ., N. J.). Plasma Phys.; 14: No. 8, 755-62(Aug 1972).

In ST Tokamak discharges with hydrogen or helium as the working gas, the measured plasma resistance is usually found to be slightly but consistently larger (1.1 to 1.5 times) than the resistance calculated from measured electron temperature and ionic charge radial profiles. The discrepancy has been ascribed tentatively to undetected high-Z material (Mo or W) from the aperture limiter. Recent experiments with neon, with effective ionic charge $Z = 9$ to 10 in the discharge, show good agreement between measured and calculated resistance. In other respects, the behavior of the neon discharge differs only slightly and in the expected direction from hydrogen or helium discharges: larger power input, higher electron temperature, and higher radiation losses. Measurement of the intensities of the recently discovered resonance lines of Mo XIII and Mo XIV indicate a molybdenum concentration in the discharges of the ST Tokamak that is adequate to account for the discrepancies in the resistance of H and He plasmas. (auth)

Kinetics (Experimental)

Refer also to abstract 57176.

57792 ELECTRON–ION RECOMBINATION IN A HELIUM PLASMA PRODUCED BY LASER. Baravian, G.; Benattar, R.; Bretagne, J.; Godart, J. L.; Sultan, G. (Univ. Paris-Sud, Orsay, France). Z. Phys.; 254: No. 3, 218-31(1972).

Experimental investigation of the recombination coefficients in a helium plasma produced by laser is reported. The relative contribution of electronic collision processes and of atomic collision processes on the values of the recombination coefficients are pointed out, according to the value of the neutral pressure of helium. (auth)

57793 ANOMALOUS PENETRATION OF A MAGNETIC PULSE INTO A PLASMA. Bengtson, Roger D. (Univ. of Texas, Austin); Marsh, S. J.; Robson, A. E.; Kapetanakos, C. A. Phys. Rev. Lett.; 29: No. 16, 1073-6(16 Oct 1972).

The penetration of a magnetic pulse into a cylindrical, field-free plasma was studied under conditions where the penetration was determined by turbulent conductivity. The penetration time was found to vary as $(M_i n_e)^{1/2}/B$, where M_i is the ion mass, n_e is electron density, and B_0 is peak amplitude of the applied magnetic field. This corresponds to a mean conductivity $\sigma \propto M_i n_e / B_0^2$. These results cannot be accounted for by any present theoretical model. (auth)

57794 ANOMALOUS RESISTIVITY AT THE INITIAL STATE OF A THETA PINCH. Shimada, T.; Sugita, K.; Masuzaki, M.; Tsuzuki, T. (Nagoya Univ, Japan). Phys. Lett.; 41A: No. 3, 263-4(25 Sep 1972).

It is found that an anomalous resistivity exists even before the implosion phase, that is, it exists already at the so-called plasma formation stage of the theta pinch in the low-pressure regime. (auth)

Kinetics (Theoretical)

Refer also to abstract 57989.

57795 (AEC-tr-7325) QUASILINEAR THEORY OF COLLISIONLESS PLASMA IN WEAK SHF ELECTRIC FIELD AND CONSTANT MAGNETIC FIELD. Gradov, O. M.; Markeev, B. M. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translation of report NP-18885. 9p. Dep. NTIS.

The equation determining the change of the distribution function under the influence of unstable vibrations is formulated, from which an equation system for moments is derived. The dynamics of low-frequency dissipative instability, the reverse effect of which on the distribution function is considered within the framework of the quasi-linear approximation, is analyzed. The analytical solution of a quasi-linear equation system for moments is found. It is shown that the system achieves a stationary state with a finite noise level. The time of establishment of the stationary state is determined. It is explained that the magnetic field can both impede establishment of equilibrium and accelerate plasma stabilization. (auth)

57796 (IPP-6/110) CURRENT AND FIELDS INDUCED IN PLASMAS BY RELATIVISTIC ELECTRON BEAMS WITH ARBITRARY RADIAL AND AXIAL DENSITY PROFILES. Kueppers, G.; Salat, A.; Wimmel, H. K. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Jul 1972. 25p. Dep. NTIS (U. S. Sales Only).

The return current and magnetic fields that result from injection of a relativistic electron beam of arbitrary radial and axial density profile into a plasma are investigated. It is found that, in general, the radial step function profile used in previous calculations overestimates the resulting B_φ field by a factor $\tau\omega_p/c$. Radial density profiles with slow variation over one skin depth, c/ω_p, yield a B_φ field screening of order $(c/\tau\omega_p)^2$, where τ is the scale length of the radial inhomogeneity. The results apply to the first (inertial) stages of beam injection, where collisions can be ignored. (auth)

57797 (LA-5031) NOTE ON INVERSE BREMSSTRAHLUNG IN A STRONG ELECTROMAGNETIC FIELD. Bethe, H. A. (Los Alamos Scientific Lab., N. Mex.). Sep 1972. Contract W-7405-eng-36. 3p. Dep. NTIS.

The collisional energy loss of an electron undergoing forced oscillation in an electromagnetic field behaves quite differently in the low and high intensity limits. In the case where the thermal velocity v_t is much larger than $v_0 = eE_0/m\omega$ the rate at which the electron transfers energy to the random motion of the medium is proportional to v_0^2. It is shown that in the case of an electromagnetic field $v_0 \gg v_t$ the rate of transfer is much slower, and actually decreases with the strength of the field. (auth)

57798 SELF-ENERGY EXPANSION FOR LINE-BROADENING. Lee, R. W. (Imperial Coll. of Science and Tech., London). J. Phys., B (London); 5: No. 7, 1271-85(Jul 1972).

A two-particle self-energy expansion is used to study spectral line broadening in plasmas. The utility of the technique is demonstrated by treating the problem in two different manners. Further possibilities are discussed, and the analytic continuation is performed. (auth)

57799 EQUILIBRIUM CONFIGURATIONS OF VLASOV PLASMAS CARRYING A CURRENT COMPONENT ALONG AN EXTERNAL MAGNETIC FIELD. Kan, J. R. (Dartmouth Coll., Hanover, N. H.). J. Plasma Phys.; 7: No. 3, 445-59(Jun 1972).

A class of equilibrium configurations of Vlasov plasmas carrying a current component along an external magnetic field is presented. The present slab model contains the diamagnetic current j_y and the field-aligned current j_z for arbitrary β_c (= particle pressure/magnetic pressure of the applied constant field). For fixed β_c and field-aligned current, the model admits a family of equilibrium solutions in which the diamagnetic currents range from zero to a maximum value. The amount of diamagnetic current flowing in a machine depends on the width of the machine, the field-aligned current, and other plasma parameters. The Helmholtz free energy of the system is calculated under the constraints that the total number of particles and the field-aligned current are conserved. The least-unstable equilibrium configuration in a machine is obtained by minimizing the free energy under the stated constraints among all equilibria whose plasma widths do not exceed the width of the machine. (auth)

57800 INFLUENCE OF ATOM-ATOM COLLISIONS ON THE COLLISIONAL-RADIATIVE IONIZATION AND RECOMBINATION COEFFICIENTS OF HELIUM PLASMAS. Drawin, H. W.; Emard, F. (CEN, Fontenay-aux-Roses, France). Z. Phys.; 254: No. 3, 202-17(1972).

Coefficients for volume recombination and ionization are calculated for a dense helium plasma of low degree of ionization. The calculations are based on a collisional-radiative model in which electron-atom, electron-electron-ion, atom-atom, and electron-atom-ion collisions intervene. Molecular species such as He_2^* and He_2^+ were not taken into account. The essential results are: at low temperatures and high neutral gas densities the recombination coefficient is proportional to the number density of neutral helium atoms. At high temperatures, the presence of neutral particles practically does not influence the recombination process compared to pure ion-electron-electron recombination. At high neutral-particle densities, high atom temperatures, and low electron densities the ionization process is mainly due to atom-atom collisions. In this point the calculations are in relatively good agreement with recent shock-tube measurements of Kalra and Measures (Phys. Fluids, 14: 2544(1971)). It is emphasized that the simple two-step model for ionization by shock waves in the noble gases should be replaced by a more general collisional-radiative model in which the atomic level structure intervenes in more detail. (auth)

57801 ELECTRON FLUCTUATIONS AND TRANSPORT IN TOROIDAL PLASMAS. Coppi, Bruno (Massachusetts Inst. of Tech., Cambridge). Contract AT(11-1)-3070. Phys. Rev. Lett.; 29: No. 16, 1076-9(16 Oct 1972).

Negative-energy modes driven by a normal gradient of the electron temperature are found in two-dimensional equilibrium configurations such as the toroidal diffuse pinch. These modes tend to grow by transferring (positive) energy to the resonating electrons; they have properties that make them suitable to alter considerably the orbits of the deeply trapped electrons by proper resonant interactions, and make them lead to electron thermal energy transport across the magnetic field without corresponding particle transport. (auth)

57802 PARTICLE CORRELATION FUNCTION OF A RELATIVISTIC PLASMA AND ENLARGED BOGOLYUBOV HYPOTHESIS. Choi, Duk-in; Baus, M. (Univ. Libre, Brussels). Transp. Theory Statist. Phys.; 2: No. 1, 69-79(1972).

It is pointed out that in relativistic plasmas the transverse-field energy density should be treated on a par with the one-particle distribution function—that is, an enlarged Bogolyubov hypothesis should be used. It is shown that, if this is not done, there will exist a discrepancy between the particle-particle correlation function as computed by the Prigogine method and the same quantity as computed by the Klimontovich method. The implications for the quasi-linear theory of relativistic plasmas are briefly discussed. (auth)

57803 CRYSTALLIZATION OF THE CLASSICAL ONE-COMPONENT PLASMA. Hansen, J. P. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Lett.; 41A: No. 3, 213-14(25 Sep 1972).

The melting line of a classical one-component plasma is determined by computing the free energies of the fluid and solid phases from "exact" Monte-Carlo equations of state. (auth)

57804 APPLICABILITY OF FOURIER'S THEORY OF HEAT CONDUCTION ON LASER-PRODUCED PLASMAS. Salzmann, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Phys. Lett.; 41A: No. 4, 363-4(9 Oct 1972).

Thermal conduction in laser-produced plasmas is usually treated by the macroscopic heat conduction equation. It is shown that this treatment can be incorrect in the case of a laser ablative implosion. (auth)

57805 TRANSITION FROM FREE-FALL TO AMBIPOLAR DIFFUSION IN THE MERCURY AFTERGLOW PLASMA. Roque, C. R.; Gregory, B. C. (Univ. of Quebec). Can. J. Phys.; 50: No. 13, 1436-48(1 Jul 1972).

A theoretical model describing the electron density and temperature decays of the mercury afterglow plasma is constructed. The plasma is assumed to be composed of six fluids: electrons, ions, ground state atoms, and metastable atoms. The transport equations based on the six-fluid model adequately describe the decay of electron density from the free-fall to the ambipolar regimes covering a pressure range of 5.8×10^{-4} to 5.8×10^{-2} torr. It is shown that charge-exchange collisions dominate the density decay at high pressures and that collisions of the second kind strongly influence the temperature decay. (auth) (Canada)

57806 SIGNIFICANCE OF HIGH MOMENTUM-TRANSFER COLLISIONS IN IONIZED GASES. Robson, R. E. (Australian National Univ., Canberra). J. Phys., B (London); 5: No. 4, 839-48(Apr 1972).

The role played by large scattering angle, high momentum-transfer collisions in the Boltzmann collision integral is discussed. In particular, the Lorentz plasma and the single-component plasma are considered. It is found that the Fokker—Planck equation, which excludes collisions involving large scattering angles, is adequate for furnishing transport coefficients, but does not provide a completely accurate representation of the anisotropic part of the distribution function. (auth)

57807 POTENTIAL SET UP BY A POINT CHARGE IN AN INHOMOGENEOUS PLASMA. Chasseriaux, J. M. (Centre National de la Recherche Scientifique, Saint-Maur-des-Fosses, Franct). Plasma Phys.; 14: No. 8, 763-81(Aug 1972). (In French).

The scalar potential set up by a point charge, fixed in position, but oscillating in magnitude, in an inhomogeneous plane-stratified cold plasma with no magnetic field was calculated. In the absence of collisions, this potential is infinite in the plane where the angular plasma frequency equals the angular frequency of the oscillating charge and is finite elsewhere, except when the plane in question contains the source: then the potential is infinite everywhere. In the presence of collisions, the potential always stays finite and the inhomogeneity of the medium then appears as an additional cause of damping of the resonances. (auth)

Production

Refer also to abstract 57774.

57808 (CEA-CONF-2019) LASERS FOR THE PRODUCTION OF DENSE HOT PLASMAS. Robieux, Jean; Blanc, Andre; Michon, Maurice (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France)). [nd]. 29p. (In French). (CONF-720438-1). Dep. NTIS (U. S. Sales Only).

From Conference on laser and fusion experiments; New York, NY. (11 Apr 1972).

The present and future objectives assigned to large lasers designed for the production of dense hot plasmas are defined. The results obtained during a year's study at the Marcoussis Research Center in the domain of glass optical lasers doped with Nd were summarized. The evolution of the characteristics of N_2-CO_2 lasers excited at atmospheric pressure is described. (tr-auth)

57809 (CEA-CONF-2022) GENERAL CHARACTERISTICS OF HEAVY ION PLASMA CREATED BY LASER. Tonon, G. (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges (France)). [nd]. 28p. (In French). (CONF-720120-1). Dep. NTIS (U. S. Sales Only).

From Conference on the sources of multicharged ions; Paris, France (28 Jan 1972).

A synthesis of the principal results obtained during the interaction of laser radiation with matter, and particularly the results concerning the charge state, the energy, and energy distribution of ions emitted by the plasma, is presented. From these results the utilization of these plasmas as a source of heavy multicharged ions is envisaged and the characteristics of the desirable laser are defined in this case. (tr-auth)

57810 PLASMA TEMPERATURE IN LASER PULSE INDUCED GAS BREAKDOWN. Ahmad, N.; Key, M. H. (Queen's Univ., Belfast). J. Phys., B (London); 5: No. 4, 866-77(Apr 1972).

Measurements of temperature in laser-pulse-induced gas breakdown are described. Data are presented for breakdown in air and helium at atmospheric pressure and above by ruby laser pulses up to 200 MW. Temperatures in the range 35 to 55 eV were obtained. It is shown that, for these conditions, temperatures are subject to much less error than those deduced using the two-foil ratio technique. (auth)

57811 FORMATION OF ROTATING PLASMAS IN A HOMOPOLAR CONFIGURATION. Barber, P. B.; Swift, D. A.; Tozer, B. A. (Central Electricity Research Labs., Leatherhead, Eng.). J. Phys., D (London); 5: No. 4, 693-700(Apr 1972).

The formation of rotating plasmas in hydrogen was studied with high-speed photographic, electrical, and magnetic diagnostic techniques. The ranges of pressure and magnetic field intensity were wide enough for both a "spoke" and a uniform "disc" mode of plasma production to be investigated. The effects of magnetic field and pressure on the form are discussed. A mechanism is considered in which plasma motion in the "spoke" mode is controlled by electromagnetically driven shock waves. (auth)

57812 THRESHOLD CONDITIONS FOR HIGH PRESSURE ARGON BREAKDOWNS PRODUCED BY A LASER BEAM. Rachman, A.; Marchal, C. (Univ., Poitiers, France). J. Phys. (Paris); 33: No. 4, 361-70(Apr 1972). (In French).

The threshold conditions for a superhigh-pressure argon breakdown to be produced by a Q-switched laser beam were analyzed. It is possible to predict some characteristic features of such plasmas that agree with experiments by assuming that the final state of the expanding plasma before the laser pulse extinction is described by a plasma model in local thermodynamic equilibrium (LTE). The well-known transfer equations and radiative equilibrium equations were integrated, and a relation was obtained between the mean laser power after breakdown and the temperature distribution inside the plasma and the initial gas pressure. (France)

57813 CALCULATION OF THE EQUILIBRIUM CONSTANTS FOR THE IONIZATION OF URANIUM AND THE DEGREE OF IONIZATION OF A URANIUM PLASMA. Kotomina, R. A. Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 15: No. 7, 1111-12(1972). (In Russian).

Theoretical equilibrium constants were calculated for the thermal ionization $U \rightarrow U^+ + e$ at temperatures from 1,000 to 20,000°K and at pressures from 0.01 to 100 atmospheres. The values of K_p ranged from 16.4 to 2.07×10^9 dynes/cm^2, and values of α ranged from 4.0 to 100%. (K.S.W.)

57814 METHOD OF PRODUCTION OF IONS AND DEVICE FOR THE APPLICATION OF THE METHOD. Eloy, Jean-Francois (to Commissariat a l'Energie Atomique). Canadian Patent 891,191. 18 Jan 1972. Priority date 15 May 1968, France.

A source was constructed that consisted of an assembly constituted by a casing, a metallic cylinder with a metallic target at the bottom, and coaxially, a perforated or extraction plate with a circular opening fitted with a grid, a preacceleration plate having an opening fitted with a grid, and a concentration electrode formed of an annular sleeve and a definition plate provided with a slit. Means are provided for exciting the target in order to produce a plasma. (Canada)

57815 HIGH-POWER LASER FOR NUCLEAR FUSION RESEARCH. Yamanaka, Chiyoe (Osaka Univ.). Oyo Butsuri; 41: No. 1, 64-8(Jan 1972). (In Japanese).

High-power laser equipment to produce plasma for nuclear fusion is discussed. To produce the fusion plasma, the laser beam needs more than some gigawatts, and the pulse rise time must be shorter than some nanoseconds. Most-important conditions for the laser beam are small beam spread and homogeneous laser distribution. Problems of a glass laser are lifetime and uniformity of spectra. To prevent diffusion of the produced plasma, the pulse width must be smaller than 1 ns. The laser pulses must be shaped at an oscillating stage. To produce some picosecond pulses, a saturable pigment may be utilized for a light valve. The high-power laser unit used here to produce plasma has the pulse width of 2 to 3 nanoseconds and an energy of 20 gigawatts. To prevent optical elements from damage caused by the reflected laser beam, a Faraday Isolator or Unigrid Shutter is employed. Breakdown of the elements restricts power output. It was found that hydrogen fluoride treatment elevates breakdown threshold of surface breakdown. It was found that plasma heating resulted from an abnormal resistivity due to the parametric instability of the plasma. (Japan)

57816 DEVELOPMENT OF THERMONUCLEAR FUSION BY THE USE OF LASER BEAM. Yamanaka, Chiyoe (Osaka Univ.). Cho-Koon Kenkyu; 8: No. 3-4, 18-25(Nov 1971). (In Japanese).

Two ways are considered for using the laser beam: rapid injection by lasers to suppress expansion of the plasma by inertia is used in inertia confinement. Another method is magnetic confinement by using carbonic-acid gas lasers. The most powerful laser at present is a short-pulse glass laser. A high-power glass laser was constructed at the Institute of Plasma Physics, Nagoya University, with the cooperation of a group from Osaka University. This laser has a power of 15 GW with the pulse width of 2 nsec. Experiments have shown that anomalous absorption was produced when the laser-beam intensity exceeded some limit, and effective heating was obtained. Total neutron yield was about 10^4 at an ion energy of 2 keV. (Japan)

Stability

57817 (UCRL–51265) FINITE BETA AND FINITE GEOMETRY EFFECTS ON MICROINSTABILITIES IN MIRROR-CONFINED PLASMAS. Tang, William M. (California Univ., Livermore. Lawrence Livermore Lab.). 18 Aug 1972. Contract W-7405-eng-48. 120p. Dep. NTIS.

Thesis.

Linear microinstabilities in collisionless, axisymmetric, mirror-confined plasmas are considered. After a review of earlier work in this area, the appropriate formalism for treating flute-type instabilities in a bounded, inhomogeneous, finite-beta plasma is determined. Conditions for the applicability of the method to both low and high frequency modes are given, and it is shown that finite-beta modifications do not alter the basic procedure, previously derived in the electrostatic limit. The general electromagnetic flute dispersion relation including finite-beta corrections to the equilibrium orbits of the particles is then derived and applied to the analysis of the Dory–Guest–Harris, drift-cone, and resonant electromagnetic instabilities. In addition to finite-geometry and finite-beta modifications, the stability analysis of the Dory–Guest–Harris mode, which is sensitive to details of the particle distribution, includes effects due to the presence of an ambipolar potential and involves the use of both theoretically evaluated and experimentally measured distributions. Stability criteria from numerical as well as analytic calculations are obtained and applied to the 2X experiment. For the case of the drift-cone instability, which had previously been analyzed only in the electrostatic limit, it is demonstrated that finite-beta effects can stabilize the mode. An analytic expression for the stability criterion is derived using a mirror-ratio-dependent loss-cone ion distribution. This result is then used to determine beta limits for stability, which prove to be insensitive to changes in mirror ratio and plasma temperature. Application of the analysis to experiment indicates that the 2X system should be unstable to the drift-cone mode and that a plasma radius on the order of 50 ion Larmor radii is required for stability. In the analysis of the resonant electromagnetic instability, it is first shown that this mode can be derived analytically in the infinite medium limit. This is verified by the close agreement between the analytic and previously calculated numerical results. It is then found that the inclusion of detailed finite-geometry effects leads to stabilization. Application of the results indicate this highly resonant electromagnetic mode should not appear in existent mirror systems. (auth)

57818 ASYNCHRONOUS EXCITATION OF A PLASMA INSTABILITY. Keen, B. E. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Phys., A (London); 5: No. 8, L74-7(Aug 1972).

Results are presented which show that the classical effect of "asynchronous excitation of an oscillator" can be applied to the excitation of an ion sound instability in a plasma. Further, the predicted upper and lower threshold values of the asynchronous driving amplitude are observed, for the region in which the instability is excited. (auth)

57819 BOUNDARY CONDITIONS IN THE PRESENCE OF HALL CURRENT OR FINITE ION LARMOR RADIUS EFFECTS. Hosking, R. J.; Kalra, G. L. (Univ. of Waikato, Hamilton, N. Z.). J. Plasma Phys.; 7: No. 3, 545-51(Jun 1972).

Boundary conditions appropriate to a model with finite ion mass corrections of ideal hydromagnetic theory are reviewed. It is shown that these boundary conditions have been correctly satisfied in earlier theory for the stability of an interface between two semi-finite regions. This theory predicts instability due to Hall current. (auth)

57820 RAYLEIGH–TAYLOR PROBLEM WITH A VERTICAL MAGNETIC FIELD, INCLUDING THE EFFECTS OF HALL CURRENT AND RESISTIVITY. Lister, G. G.; Hosking, R. J. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). J. Plasma Phys.; 7: No. 3, 553-62(Jun 1972).

The influence of resistivity and Hall current on the Rayleigh–Taylor problem involving two superposed fluids of finite density in the presence of gravitational and magnetic fields normal to the fluid interface is examined. Unlike the related problem in which the magnetic field is parallel to the interface, it appears that the dispersion relation does not exhibit singular behavior in the zero-resistivity limit. The "potentially stable" situation is considered throughout. The results are compared with earlier ideal and resistive theories, and an apparent anomaly regarding the existence of normal modes in such systems is resolved. (auth)

57821 THERMODYNAMIC DESCRIPTION AND STABILITY CONDITION OF A NONVISCOUS PLASMA IN STEADY MOTION. Lebon, G.; Casas-Vasquez, J. (Univ., Louvain, Belg.). Ann. Soc. Sci. Brux. Ser. I; 86: No. 2, 227-40(15 Aug 1972).

It is shown that the stationary motion of a compressible and fully ionized plasma may be described by a variational principle expressing that the rate of entropy production is extremum when the generalized thermodynamic fluxes are kept constant. The problem of the stability of the motion is also examined. Using Liapunov's method, a sufficient condition for stability is given. (auth)

57822 PLASMA TURBULENCE: THEORIES AND EXPERIMENTS. Gentle, K. W. (Univ. of Texas, Austin). Radio Sci.; 7: No. 8-9, 799-808(1972).

Although there is still only an incomplete understanding of plasma turbulence, knowledge has increased rapidly during the past few years. For weak turbulence, theory and experiment agree on the nature and strength of the interactions that occur. For strong turbulence, there is no general theory, but for some cases experimentally confirmed phenomenological laws enable quantitative estimates of the turbulent effects to be made. (30 references) (auth)

57823 COMBINED RAYLEIGH AND KELVIN INSTABILITY OF A HALL PLASMA WITH A VERTICAL MAGNETIC FIELD. Bhowmik, G.; Talwar, S. P. (Univ. of Delhi). Can. J. Phys.; 50: No. 13, 1487-93(1 Jul 1972).

The problem of Rayleigh–Taylor and Kelvin–Helmholtz instability for an electrically conducting incompressible Hall plasma supported by a nonconducting and uniformly streaming compressible gas is investigated with an ambient vertical magnetic field. The resistivity and the finite ion Larmor frequency are both found to have a destabilizing effect as also the streaming speed and the compressibility of the gaseous medium. (auth) (Canada)

57824 SUPPRESSION OF HELICAL HYDROMAGNETIC INSTABILITIES OF A CURRENT-CARRYING PLASMA COLUMN BY MEANS OF FEEDBACK SYSTEMS. Arsenin, V. V. At. Energ. (USSR); 33: No. 2, 691-5(Aug 1972). (In Russian).

Suppression of long-wavelength helical hydromagnetic instabilities in a toroidal plasma column by means of feedback systems controlling magnetic field perturbations in vacuum is considered. The model used is a straight, ideally conducting, incompressible plasma cylinder having uniformly distributed axial current and azimuthal and axial surface currents. The simplest linear stabilization system, equivalent to a metal casing near the plasma, suppresses the instability of a column having uniformly distributed axial current both in the absence and in the presence of surface azimuthal current (rough models of tokamak with $\beta_y = 1$ or $\beta_y \neq 1$). The stabilization problem is simplified if the axial current density decreases with radius. In such a system, one can also stabilize the first azimuthal mode in screw θ-pinch under certain conditions and in paramagnetic pinch. A nonlinear scheme to suppress convective perturbations is also discussed. (17 references.) (auth)

57825 EVOLUTION FROM LINEAR TO NONLINEAR SATURATION OF INSTABILITIES IN PLASMA AND CHANGES IN ZEROTH-ORDER CONDITIONS. Sato, Masumi (Yamagata Univ., Yonezawa, Japan). Yamagata Daigaku Kiyo, Kogaku; 11: No. 2, 229-39(Mar 1971).

An evolution from the linear growth to the nonlinear saturated state of instability is investigated by observing the spatially growing ionization waves (moving striations) in a plasma. The behavior of the instability is shown to obey the Landau amplitude equation. An initial infinitesimal oscillation grows exponentially and reaches a saturated equilibrium amplitude which is independent of the initial value. When the saturation occurs, partial and gradual change in zeroth-order conditions by the nonlinear effect is also found. The way of these behaviors can be applied to a large number of spatially or temporally unstable modes. (auth)

Thermonuclear Processes

Refer also to abstracts 55953 and 55973.

57826 (AEC-tr-7328) MULTITUBE GENERATING BANK. Zverev, G. I.; Lyul'ev, V. L.; Mayburov, V. B.; Savchenko, I. S.; Yampol'skii, I. R. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Sukhumi. Fiziko-Tekhnicheskii Institut). Translation of report NP–18943. 8p. Dep. NTIS.

Quadriphase tube generators for excitation of loops generating high-frequency fields of various configurations, used in plasma physics studies, are described. The generators can operate in two modes: independent excitation and self-oscillation. In the self-oscillation mode the load is the contour that generates the field. The summary steady-state tube power of the generating bank exceeds 80 MW with pulsation of 1 to 1.5 msec, pulse modulation frequency 0.5 to 2 MHz and pulse spacing frequency 0.05 to 0.1 Hz. The problem of achieving high power is solved by summing the powers of groups of parallel-connected generating tubes in load. (auth)

57827 (CONF-720627–, pp 12.1-10) FUSION POWER PROSPECTS RELATIVE TO FISSION. Peaslee, D. C. (Australian National Univ., Canberra).

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

An attempt is made to assign rough time scales to the advent of fusion power in Australia by extrapolating the growth rates of breeder reactors and the as-yet-unborn fusion reactors following an estimated time scale for electricity generation by fossil, ^{235}U, and breeder reactor fuels. Some technical approaches to fusion power are briefly described. (Australia)

57828 (EUR-CEA-FC-653) DESCRIPTION OF THE CIRCE EXPERIMENT. Bardet, R.; Dupas, L.; Gormezano, C.; Melin, G. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). May 1972. 36p. (In French). Dep. NTIS (U. S. Sales Only).

An external cold plasma is injected into an open-ended minimum-B system through a magnetic mirror. The electrons are heated at the electron cyclotron resonance (8 GHz at 25 kW). The ions are confined by the electrostatic potential well, whose depth is determined by the balance of ion and electron losses. (France)

57829 (GA-A-12239) CONTROLLED THERMONUCLEAR RESEARCH PROGRAM. Summary Progress Report for the Period August 1, 1971–July 31, 1972. Ohkawa, Tihiro (Gulf General Atomic Co., San Diego, Calif.). 15 Sep 1972. Contract AT(04-3)-167. 102p. Dep. NTIS.

The continuing development of Doublet II hardware is described. The vacuum system, coils, power supplies, and diagnostic techniques are discussed. Plasma diffusion and confinement research in the dc Octupole are also outlined. (M.O.W.)

57830 (IPP-4/1) FUNDAMENTAL CALCULATIONS FOR CROWBAR AND POWER-CROWBAR DISCHARGES. Oswald, B. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Jun 1962. 36p. (In German). Dep. NTIS (U. S. Sales Only).

For Crowbar hookups, mathematical equations are derived for the following aspects of the first discharge step: time dependency of current, time dependency of voltage, maximal current with respect to time, and passage of voltage through zero with respect to time. For the second discharge step, equations are given for time course of current in the user, time course of voltage, current rise at the beginning of the second step, voltage minimum with respect to time, and current in the Crowbar branch. Under power, Crowbar hookups are treated time course of current and voltage, current maximum, voltage extremes, slow chief discharger with fast predischarger, and Corwbar and power Crowbar hookups in fast discharge circuts. (H.B.G.)

57831 (NP-19456) ANNUAL REPORT, 1971. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). 1971. 293p. (In German). Dep. NTIS (U. S. Sales Only).

Experimental research is described for the following: (1) ISAR devices, (2) theta pinches with external magnetic fields, (3) Wendelstein devices, (4) Pulsator experiments, (5) MHD generators, (6) surface physics, and (7) relativistic plasmas. Associated theoretical work is also described. (M.O.W.)

57832 (UCRL-73952) NEUTRONICS OF SUB-CRITICAL FAST FISSION BLANKETS FOR D-T FUSION REACTORS. Lee, J. D. (California Univ., Livermore. Lawrence Radiation Lab.). 15 Jun 1972. 14p. (CONF-720925). Dep. NTIS.

From seventh intersociety energy conversion engineering conference; San Diego, CA. (25 Sep 1972).

The coupling of fusion and fission has the potential of significantly reducing plasma confinement criteria below that required for a pure fusion system while also reducing fissile fuel doubling times below those possible with pure fission systems. To give a better feeling for fusion–fission's potential, and problems, a neutronic appraisal of the subcritical fast fission blanket concept is presented. Results indicate energy increases over nonfission blankets of a factor of 10 to 20 (250 to 500 MeV per 14-MeV fusion neutron) are possible in blankets where tritium breeding, cooling, structure, and fissile fuel breeding requirements are considered. (auth)

57833 PRELIMINARY OBSERVATIONS ON THE RADIOLOGICAL IMPLICATIONS OF FUSION POWER. Steiner, D.; Fraas, A. P. Nucl. Safety; 13: No. 5, 353-62(1972).

The radiological implications of fusion power are considered with reference to a conceptual fusion reactor based on the deuterium–tritium fuel cycle. This analysis leads to the following observations: (1) The engineered features necessary to limit biological impact in the event of an accident may have to satisfy less stringent requirements in fusion-reactor design than in fission-reactor design. (2) During normal operation, tritium will present the primary source of radioactivity in effluents associated with fusion power. The monitoring of tritium in effluents will be required only at the reactor site since the fuel-reprocessing system of a fusion reactor is an integral part of the reactor. Economic containment of tritium must be a major objective of fusion-reactor technology. (3) Long-lived radioisotopes will be produced in the structural components of fusion reactors. If niobium is employed as the structural material, disposal schemes similar to those currently proposed for fission-reactor wastes may be required. If vanadium is employed, recycle of the structural material appears possible. (4) Although afterheat removal will be quantitatively less of a problem with fusion power than with fission power, it must be considered in the engineering design of fusion reactors. (auth)

57834 ROAD TO CONTROLLED NUCLEAR FUSION. Artsimovich, L. (Inst. of Physics, Moscow). Nature (London); 239: No. 5366, 18-22(1 Sep 1972).

The present state of research into controlled thermonuclear fusion is reviewed and its prospects are assessed. Topics discussed include temperature and confinement, magnetic confinement, Tokamaks, stellarators, magnetic mirrors, and laser heating. (UK)

57835 PLASMA PHYSICS INDEX. VOLUME 7, NO. 7, 1972. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 161p.

This listing contains 436 references on various aspects of the title subject. (M.O.W.)

57836 IMPROVEMENTS IN LASER BEAM COMPRESSION GUNS. Pedrick, Arthur Paul. British Patent 1,282,391. 19 Jul 1972. Filed 17 Sep 1970.

The main function of "laser beam compression guns" (as described in BP 1,207,698) is to generate, in a controlled manner, the very high temperatures, believed to be of the order of 50 million °C, required to bring about reaction between D and T in fusion systems, or about 400 million for D + D reactions. The action of the gun depends on feeding pulses of light energy from high-power laser devices immediately in front of a bullet or piston moving at very high speed down a tube as a result of firing of an explosive charge. Laser photons are reflected off an end mirror back on to the mirror face of the bullet or piston, then back on to the end mirror, and so on. In this way the energy from numbers of such pulses is concentrated into a smaller and smaller space as the bullet approaches the end mirror, until it fractures a diaphragm designed for the purpose; a high concentration of radiant energy is thus immediately released from the tube, and is concentrated again by a suitable lens upon a small sphere containing D and T under high pressure. At every reflection of the laser beam pulses, before the energy is released through the lens, some energy is lost as heat and it is thus desirable that the speed of the bullet shall be as high as possible so as to reduce the number of reflections. An arrangement is described for obtaining a bullet speed as near as possible to the speed of light. The tube is evacuated to a high degree and the piston or bullet contains at least one permanent magnet the poles which are arranged to be repulsed by like poles of electromagnets arranged along the base of the tube thus raising the piston or bullet off the tube and reducing frictional resistance to a minimum. (UK)

57837 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. VOLUME 6, NO. 8, 1972. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 47p.

This listing contains 222 references on various aspects of controlled fusion research. (M.O.W.)

57838 METHOD AND DEVICE FOR THE CONFINEMENT AND HEATING OF AN IONIZED PLASMA, ESPECIALLY FOR THE PRODUCTION OF A CONTINUOUS NUCLEAR FUSION. Ensley, D. L. (to Power, Inc.). German Patent 2,140,166. 30 Mar 1972. (In German).

This device allows the production of standing electromagnetic waves in a cavity of a given shape and volume, where the electric component of the wave is a minimum near the wall, that means running nearly parallel to the wall. The amplitude and frequency of this wave can be varied as a function of the amount of the filling gas (D or T) so that a stable plasma of the density of 10^{13} to 10^{14} ions/cm^3 is generated. A circularly or elliptically polarized electromagnetic wave can be generated within the cavity whose walls are cooled to maintain superconductivity. The feeding of microwave power can be carried out under conditions offering appropriate radiation protection. (GF)

57839 MULTIAMPERE DUOPIGATRON ION SOURCE (1 Mar 1972) (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE–2252).
9 drawings.

This ion source, a modification of a four-electrode Cu-anode duoplasmatron, consists of a duoplasmatron feeding a PIG discharge system. The source electrodes and magnetic fields produce a large uniform plasma surface from which ions are extracted through multi-aperture electrodes. The extraction electrodes, located at the end of the PIG discharge opposite the duoplasmatron, are accel–decel with 5-cm-dia multiapertures. The source is simple, efficient, and operates stably over a large variation in source pressure. Beams of 1A are extracted in steady-state operation with ion energies from 1.5 to 5 keV. Beams of 4A are extracted with 0.1-sec pulses and 10% duty cycles at ion energies of 20 to 40 keV. At 30 to 40 keV, about 60% of the ion beam is within a half-angular divergence of 1.2° with no magnetic range. Using a H-gas cell, this system produces 2.6A (equivalent) of 17.5- and 35-keV H° particles within a half-angular divergence of 1.2°. Multiampere beams are produced with a significant fraction of the particles being molecular ions. The beams consist of 50% H^+ and 50 H_2^+ at 3 to 4A. About 0.65 of the H^+ and 0.8 of the H_2^+ ions (implying 1.6 H° per H_2^+) from a 35-keV beam are converted into neutral particles in the H-gas cell. (For details see TID-4100 Suppl. 72) (F.S.)

57840 PROGRESS AND FUTURE OF THERMONUCLEAR FUSION RESEARCH AND DEVELOPMENT. Sekiguchi, Tadashi (Tokyo Univ.). Oyo Butsuri; 41: No. 1, 41-50(Jan 1972). (In Japanese).

Deuteron-induced reactions available for power reactors are discussed, and conditions that sustain the reactions by themselves are illustrated. Several methods to confine high-temperature plasma are explained. The concept of absolute-minimum magnetic field configuration was applied to a magnetic-mirror system. A system called multipole-torus was developed to improve torus-type devices. The apparatuses described are grouped into a low-beta category, and are the main apparatuses for the study on fusion reactors at present. (Japan)

57841 POSSIBILITY OF PRODUCING PLASMA REGIONS AT THERMONUCLEAR FUSION CONDITIONS IN A SUPERSONIC FLOW BY MEANS OF HIGH POWER ELECTRON BEAM. Giovanelli, R. (Univ., Ancona, Italy). Plasma Phys.; 14: No. 9, 887-91(Sep 1972).

A device is proposed intended to generate a high-velocity plasma jet to produce thrust for space vehicle propulsion. A hot stationary D–T plasma region is surrounded by supersonically flowing insulating gas. A preliminary calculation of the overall energy balance indicates that this configuration could result in effective nuclear fusion with the energy released in the exhaust gas flow. (auth)

57842 J x B TYPE PLASMA GUN FOR CLOSED MAGNETIC TRAP EXPERIMENT. Inoue, N.; Kawasumi, Y.; Miyamoto, K. (Nagoya Univ., Japan). Plasma Phys.; 14: No. 9, 891-5(Sep 1972).

A type of J x B plasma gun is described that utilizes a low-voltage arc plasma. The number and the energy of the plasma particles can be varied by controlling the quasi-steady arc current. The low voltage of the gun enables a compact plasma gun to be constructed that can be mounted on the discharge tube. The experiment and observation of several properties of the plasma are described. (auth)

57843 ASSESSMENT OF SOME MATERIALS PROBLEMS FOR FUSION REACTORS. Draley, J. E.; Frost, B. R. T.; Gruen, D. M.; Kaminsky, M.; Maroni, V. A. (Argonne National Lab., Ill.). pp 1065-75 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The following four areas are considered: vacuum wall materials, vacuum wall surface effects, the blanket, and tritium balance problems. For each of these areas, the materials requirements, problems that complicate the satisfaction of the requirements, and needs for information or research and development to satisfy the requirements are discussed. (50 references) (M.O.W.)

57844 ENERGY STORAGE AND SWITCHING WITH SUPERCONDUCTORS AS A POWER SOURCE FOR MAGNETIC FIELDS IN PULSED THERMONUCLEAR EXPERIMENTS AND REACTORS. Laquer, H. L.; Ribe, F. L.; Weldon, D. M. (Los Alamos Scientific Lab., N. Mex.). pp 1089-95 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The circuit parameters for various storage and switching configurations were analyzed as well as the amount of superconductor required for different transfer times and for different material properties. The results are presented of a preliminary study on the use of superconductive storage and switching in a large-scale experiment aimed at demonstrating scientific feasibility of controlled fusion. Experimental studies were made of the maximum stable currents attainable before switching and the limiting switching times as a function of diameter (thickness) and composition for a number of superconducting materials. (auth)

57845 ECONOMICS OF TOROIDAL FUSION REACTORS. Carruthers, R.; Hancox, R. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 1109-17 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Comparative cost studies are made of a number of possible types of toroidal fusion reactor. Real containment field configurations are considered as compared with the simplified structures adopted in previous studies. The effect on the economics of the presently understood limitations in β is considered. It is shown that devices requiring complex magnetic fields, such as the stellarator, will probably only be economic in very large units unless β can be raised above the theoretical limit. The steady state tokamak will lead to an economic reactor provided the diverter problem can be solved without adding too much to the magnetic complexity. In all cases the economics are very dependent upon the price of superconductors and there is a clear need for high field materials at prices well below those prevailing today. (auth)

57846 LASER FUSION: A NEW APPROACH TO THERMONUCLEAR POWER. Mitz, William D. Science; 177: No. 4055, 1180-2(29 Sep 1972).

A brief survey of laser fusion research is presented. The possibilities and attractiveness of using multiple lasers for irradiation of deuterium–tritium pellets for thermonuclear power are described. Some technical problems are also considered. (M.O.W.)

Wave Phenomena

Refer also to abstract 57078.

57847 (AEC-tr–7321) STUDY OF ABSORPTION OF SHF WAVES BY PLASMA AT UPPER HYBRID FREQUENCIES. Anisimov, A. I.; Vinogradov, N. I.; Golant, V. E.; Pakhomov, L. P. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). Translation of report NP-18807. 9p. Dep. NTIS.

Studies on spatial distribution of concentration of charged particles in a toroidal magnetic field yielded information on the drift rate and on the absorption of shf waves by the plasma. It was shown that the absorption of shf waves by the plasma was localized in a comparatively narrow region of 1.5 to 2.0 cm. The localization region of the absorption of shf energy coincided with the region of propagation of plasma waves forming as the result of linear transformation of an electromagnetic wave introduced from outside, and the attenuation length was close to the calculated length of absorption of these waves. (auth)

57848 (FRNC-TH–217) INVERSE FARADAY EFFECT IN A PLASMA. Lagoutte, Martine (Paris Univ., Orsay (France)). [nd]. 51p. (In French). Dep. NTIS (U. S. Sales Only).
Thesis.

The existence of an inverse Faraday effect in a plasma was demonstrated. The linear variation of the magnetic field produced, with the square of the electric field component of the exciting wave (circularly polarized electric field) was verified. The plasma was formed by transforming a 3000 MHz electromagnetic signal having a power of a few megawatts and a duration of 12 μs into a circularly polarized wave, electrons having the closed trajectories at the origin of the magnetic field being produced. The existence of this field was confirmed from measurements made of the flux variations induced in a coil wound around the plasma. The results are described in terms of a simple theory neglecting internal polarization effects in the plasma. It was, however, only possible to perform a complete calculation for simple geometrical configurations (difficult to conceive) as the metallic elements of the set up used modified the flux variations across the coil. (France)

57849 (UCRL—51254) COMPONENTS OF ELECTROMAGNETIC STRESS TENSOR IN PLASMA. Shearer, J. W. (California Univ., Livermore. Lawrence Livermore Lab.). 30 Aug 1972. Contract W-7405-eng-48. 10p. Dep. NTIS.

This report is a supplement to a recent paper by the author and James Eddleman which derived the forces exerted by a transverse electromagnetic wave on a fully ionized plasma. Here the stress-tensor formalism is more fully examined for the case of an approximately plane parallel wave. An erroneous derivation of the ''pondermotive'' forces is compared to a correct derivation of them. (auth)

57850 COUPLED FIELDS IN INHOMOGENEOUS WARM PLASMAS WITH STATIC PRESSURE GRADIENTS. I. Burman, R. (Western Australia Univ., Nedlands). Proc. Cambridge Phil. Soc.; 72: No. 2, 285-97(Sep 1972).

Small amplitude waves in inhomogeneous warm electron plasmas are discussed. The waves are coupled electromagnetic and electron-acoustic waves, and are described by Maxwell's equations together with single-fluid hydrodynamical equations. Previous work is generalized by including the effect of a static pressure gradient. Coupled wave equations are obtained and specialized to the case of a planar stratified plasma. As a preliminary to a treatment of wave coupling, the behavior of the solutions of the uncoupled wave equations in a coupling region is investigated. The static pressure gradient complicates the behavior of the uncoupled field components; singularities occur at two points which coalesce as the static pressure gradient is allowed to tend to zero. (auth)

57851 DEPRESSION OF THE POWER SPECTRUM OF COMPTON RADIATION FROM RELATIVISTIC PARTICLES IN A RAREFIED PLASMA. Getmantsev, G. G.; Tokarev, Yu. V. (Radiophysical Research Inst, Gorky, USSR). Astrophys. Lett.; 12: No. 1, 57-60(Sep 1972).

An expression is obtained for the frequency spectrum of Compton radiation from an ensemble of relativistic charged particles with a given power spectrum. The refractive index of the medium in which the particles move is taken into account. The influence of the refractive index of the medium on the frequency spectrum in the case of synchrotron radiation is compared with that for Compton radiation. (auth)

57852 EFFECTS OF INDIVIDUAL LINEAR DAMPING ON NONLINEAR INSTABILITY. Weiland, J. (Chalmers Tekniska Hoegskola, Goeteborg). J. Plasma Phys.; 7: No. 3, 375-84 (Jun 1972).

A computer investigation was made for the problem of three coherent waves in a plasma system, assuming a nonlinearly unstable situation and mutually different linear damping of the three interacting waves. The results agree satisfactorily with those of an analytic approach to the problem. The solution near the explosion time was further examined and a method is suggested of expressing the solution of the system for mutually different values of the imaginary parts of the frequencies in terms of the solution for which all these imaginary parts are zero. (auth)

57853 SIDEBAND GROWTH IN NONLINEAR LANDAU WAVE-PARTICLE INTERACTION. Brinca, A. L. (Stanford Univ., Calif.). J. Plasma Phys.; 7: No. 3, 385-402(Jun 1972).

The distortion of the electron velocity distribution caused by a large-amplitude Landau wave is determined analytically for the initial-value problem. The resulting stability of electrostatic perturbations impressed on the evolving plasma is studied. Narrow sidebands of the applied frequency experience consecutive growths of large magnitude during the early stages of the nonlinear wave— particle interaction. The significance of the derived results to both wave propagation experiments and triggered vlf emissions in the magnetosphere is discussed. (auth)

57854 EXCITATION OF NANOSECOND WAVES ON POSITIVE COLUMNS. Anicin, B. A.; Babovic, V. M.; Lonngren, K. E. (Boris Kidric Inst. of Nuclear Science, Belgrade). J. Plasma Phys.; 7: No. 3, 403-16(Jun 1972).

Nanosecond pulses were launched and propagated on a positive column in the form of electron waves. The dispersion of the pulses was studied experimentally and was found to be in agreement with monochromatic experiments and theory. Apart from wave attenuation, which was observed to depress signals of higher frequencies, Fourier analysis of the received pulses revealed that the launching mechanism favors frequencies in the vicinity of $\frac{1}{6}\omega_p$. A full-wave theory, based on an extension of Goubau's excitation theorem, is derived, and successfully contrasted with experiment. (auth)

57855 LONGITUDINAL WAVES IN A PERPENDICULAR COLLISIONLESS PLASMA SHOCK. 4. GRADIENT B. Gary, S. P. (Coll. of William and Mary, Williamsburg, Va.). J. Plasma Phys.; 7: No. 3, 417-25(Jun 1972).

Electrostatic waves in a Vlasov plasma of unmagnetized ions and magnetized electrons undergoing $E \times B$ and gradient-B drifts are examined. The linear dispersion relation is solved numerically for $T_e \sim T_i$. The results show that, as in the $T_e \gg T_i$ case, increasing electron β decreases the maximum growth rates. (auth)

57856 TEMPORAL ELECTROMAGNETIC ECHOES OBLIQUE TO AN EXTERNAL MAGNETIC FIELD. Furutani, Y. (Paris Univ., Orsay, France). J. Plasma Phys.; 7: No. 3, 461-73 (Jun 1972).

An exact Green's function of the Lenard—Bernstein equation for a magnetoplasma subjected to an external dc electric field is obtained. The result is applied to the problem of temporal electromagnetic echoes which can be detected at any angle of observation with respect to the external magnetic field B_0. (auth)

57857 NONLINEAR EVOLUTION OF FIREHOSE-UNSTABLE ALFVEN WAVES. Elsaesser, K.; Schamel, H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). J. Plasma Phys.; 7: No. 3, 475-502(Jun 1972).

The time evolution of firehose-unstable Alfvén waves is calculated within the usual weak-turbulence scheme. The amplitude equations are established using a third-order solution of Vlasov's equation. From these a spectrum equation is obtained by discarding four-wave correlations; in addition, an equation that characterizes the truncation error is derived. Both these equations are integrated numerically, together with the velocity-moment equations, forward in time. The results as presented correspond to a rapid relaxation of the plasma to equilibrium. For large wave vectors the relaxation time, as well as the equilibrium wave energy, are in good agreement with the quasi-linear treatment, and the truncation error is small. But for low wave numbers the relaxation is much faster, and the wave energy grows higher as predicted by quasi-linear theory. (auth)

57858 HIGH-β EFFECT ON THE GENERALIZED ION BERNSTEIN MODE NEAR THE LOWER HYBRID FREQUENCY. Nambu, M. (Tokyo Univ.). J. Plasma Phys.; 7: No. 3, 503-12(Jun 1972).

The dispersion curves of mixing mode between electrostatic and electromagnetic waves propagating perpendicularly to the ambient magnetic field are computed for the frequency range near the lower hybrid frequency in the case of a finite-β plasma with a Maxwellian velocity distribution. The detailed results apply to a hydrogen plasma. The result indicates that the lower hybrid frequency is neither the resonance frequency of the electromagnetic wave nor the cutoff frequency of the electrostatic wave. In a high-β plasma, the plateau of the dispersion curve disappears and the electrostatic approximation (Bernstein mode) is not valid up to the wavelength of the order of proton Larmor radius. The polarization is left-handed, and a trace of the most dominant intensity ratio of wave magnetic field energy to the electric field energy in each branch is given approximately by the cold-plasma dispersion curve. (auth)

57859 BOUNDARY PROBLEM IN A PLASMA (OBLIQUE INCIDENCE). Karunarathne, V. B. (Univ. of Ceylon, Peradeniya). J. Plasma Phys.; 7: No. 3, 513-22(Jun 1972).

An isotropic plasma occupies an infinite space, the upper half of which $(y > 0)$ is a dielectric. A transverse disturbance is incident obliquely on the face of the dielectric. The waves produced in each half of the space are obtained. Possible extensions are discussed. Some particular examples are considered. (auth)

57860 SCATTERING OF LANGMUIR WAVES PRODUCED BY A BEAM WITH FINITE TRANSVERSE DIMENSIONS. Berthomieu, G. (Observatoire de Nice). J. Plasma Phys.; 7: No. 3, 523-43(Jun 1972).

It has been proposed that type-III radio bursts may be produced by streams of protons with radius of the order of 7 km, which is of the same order as the characteristic lengths of the nonlinear processes supposed to take place in the dynamics of these bursts. A method for studying systems with finite transverse dimensions is considered and applied to a simple model: the scattering of a beam of plasma waves by acoustic turbulence and by the particles of the plasma. (auth)

57861 SURFACE WAVES IN HOT PLASMAS. Barr, H. C.; Boyd, T. J. M. (University Coll. of North Wales, Bangor, Eng.). J. Phys., A (London); 5: No. 7, 1108-18(Jul 1972).

Vlasov's equation and the full set of Maxwell's equations are solved as an initial-value problem in a semi-infinite plasma. On specifying boundary conditions, a dispersion relation is obtained for surface waves in two situations, one without a wave incident on the boundary, the other with such a wave. The former case includes all previous results as special cases. In the latter case, it is found that surface waves cannot be excited by a wave incident on the boundary. (auth)

57862 GROWTH RATE AND FREQUENCY DISPERSION CHARACTERISTICS OF DRIFT WAVES IN AN RF COLLISIONAL PLASMA. Keen, B. E.; Alcock, M. W. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Phys., A (London); 5: No. 7, 1095-1107(Jul 1972).

Results are presented for a low-frequency self-excited oscillation in an inhomogeneous rf collisional plasma. In this plasma the radial electric field is very small, so that the resulting plasma rotation can be neglected, thus simplifying the interpretation of the experimentally measured frequencies. The oscillations occurred as azimuthally propagating waves with predominantly m = +1 mode number, and as standing waves in the axial direction with approximately half a wavelength in the tube. The frequency was dependent on the tube length, the axial magnetic field, and the gas neutral pressure, and measurements were made in both helium and hydrogen plasmas while varying these parameters. By using a method of dynamic stabilization to reduce the instability to a low level, frequency measurements were made in the linear regime where most linearized theories apply. Also, by analyzing the subsequent return of the oscillations to its saturation level the linear growth rate was obtained. Comparison of these growth rate and frequency measurements in the linear regime with a previous theory of the drift-dissipative instability shows reasonably good agreement. (auth)

57863 LAGRANGIAN STUDIES OF PLASMA WAVE INTERACTIONS. I. Boyd, T. J. M.; Turner, J. G. (University Coll. of North Wales, Bangor, Eng.). J. Phys., A (London); 5: No. 6, 881-96(Jun 1972).

A study of wave—wave interactions in plasmas is made using a lagrangian formulation developed by Low (Proc. Roy. Soc., A248: 282-7(1958)). Coupled-mode equations are derived. The method offers distinct advantages over the conventional approach starting from the Vlasov—Maxwell equations. Two examples of the lagrangian method was considered: (i) the nonlinear interaction of transverse waves in a warm field-free plasma to produce plasma oscillations and (ii) the interaction of three electromagnetic waves in a cold magnetized plasma. (auth)

57864 DAMPING OF FINITE-AMPLITUDE ELECTRON PLASMA WAVES IN A COLLISIONLESS PLASMA. Franklin, R. N.; Hamberger, S. M.; Smith, G. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Rev. Lett.; 29: No. 14, 914-17(2 Oct 1972).

Experimental measurements of the collisionless damping of a finite-amplitude electron wave confirm recent self-consistent numerical solutions of the nonlinear Vlasov equation. (auth)

57865 ATTENUATION OF WAVES IN PLASMAS. Suchy, Kurt (Centre National de la Recherche Scientifique, Saint-Maur, France). Radio Sci.; 7: No. 8-9, 871-84(1972).

Among the variety of problems arising from attenuating influences on the propagation of waves, three will be reviewed: (a) determination of the correct gas-kinetic description of collisions between the plasma particles and their relation to the conductivity tensor and the dispersion equation, (b) the generalization of the basic laws of geometric optics for moderate collisional absorption, and (c) the calculation of wave-mode attenuation arising from linear-mode coupling in a full-wave theory for a cold, stratified, magnetized absorbing plasma. (43 references) (auth)

57866 INSTABILITY OF INHOMOGENEOUS PLASMA STREAMS. Zhelyazkov, I.; Rukhadze, A. A. (Lebedev Inst. of Physics, Moscow). Radio Sci.; 7: No. 8-9, 857-70(1972).

The instability of plane-parallel plasma streams with a nonuniform velocity profile, both in the absence and in the presence of a longitudinal magnetic field, was investigated. The results for plasma streams are compared with those of ideal conductive liquid flows. Although for instability in a plane-parallel ideal-liquid flow the theorem of Rayleigh (1880) is valid, it is not so for plasma streams. (57 references) (auth)

57867 REVIEW OF WAVE EXCITATION IN PLASMAS. Johnston, Tudor Wyatt (Univ. of Houston, Tex.). Radio Sci.; 7: No. 8-9, 833-41(1972).

The excitation of plasma waves is reviewed, organized according to the mode of excitation: linear wave coupling, use of exciters (such as antennas and probes), particle-velocity anomalies (such as streams and loss cones), and wave—wave stimulation (such as three-wave and echoes). (128 references) (auth)

57868 LINEAR AND NONLINEAR COUPLING OF WAVES IN PLASMAS. Larenz, R. W. (Univ., Duesseldorf). Radio Sci.; 7: No. 8-9, 845-52(1972).

A survey of wave-coupling phenomena is given. Different physical influences are discussed from a rather general plasma-wave equation displaying these influences. Nonlinear interaction is considered and some basic examples are given. Attention is called to certain physical points of view related to nonlinear analysis. (auth)

57869 INSTABILITY OF THE WHISTLER STRUCTURE OF OBLIQUE HYDROMAGNETIC SHOCKS. Decker, G.; Robson, A. E. (Univ. of Texas, Austin). Phys. Rev. Lett.; 29: No. 16, 1071-3 (16 Oct 1972).

The characteristic whistler structure of oblique hydromagnetic shocks is observed experimentally to suffer from a rapidly growing short-wavelength instability, which is tentatively identified as the decay instability first predicted by Galeev and Karpman. It is suggested that this instability is responsible for the turbulent whistler shock structure observed when a super-Alfvénic plasma stream encounters a magnetic obstacle. (auth)

57870 DESCRIPTION TO ALL ORDERS IN ELECTRON AND ION TEMPERATURES OF WAVES IN MAGNETIZED NONUNIFORM PLASMA. Monfort, J.-L.; Vandenplas, P. E. (Ecole Royale Militaire, Brussels). Transp. Theory Statist. Phys.; 2: No. 1, 1-26(1972).

Using an operator method, a general description of waves (including the correct differential equations for the electromagnetic field) in nonuniform magnetized plasmas is given to all orders in electron and ion temperatures provided a few not-too-restrictive assumptions are made. This permits a correct differential treatment of a bounded plasma to a given order in temperature. When the plasma is uniform, this furnishes a useful temperature-ordered form of the corresponding dispersion equation. If the quasi-static approximation is made, one obtains the Bernstein-type description of a plasma. (auth)

57871 COLLECTIVE EFFECTS IN THREE-PULSE CYCLOTRON ECHOES. Smith, Richard Ross. Pasadena, Calif.; California Inst. of Tech. (1972). 132p. University Microfilms Order No. 72-22,614.

Thesis.

Three-pulse cyclotron echoes, 3 PE, in rare-gas afterglow plasmas were investigated. The experiments were performed with the magnetic field parallel to the discharge tube, which passes perpendicularly through an S-band waveguide. The echo properties were experimentally shown to be incompatible with previous models. Experiments performed on 3 PE showed that the electron density is the most important parameter, especially for the growth and decay of the echo following the first two pulses. The density is shown to have a qualitative as well as quantitative effect on the echo. Periodic modulation of both the emission and absorption of the plasma is observed following the first two pulses, and these additional methods of investigating echo processes will be helpful in formulating a satisfactory theory. A model containing the experimentally important parameters is developed, and it is based upon the relatively simple case of the generation of plasma waves following an impulsive excitation for times so small that the original transient response has lost negligible energy. Better agreement than with previous theories is obtained, especially in the qualitative dependence of the echo on the electron density. Electron velocity space instabilities are briefly examined and discarded as influences in echo experiments. The detection and qualitative theoretical explanation of slow wave pulses created inside the plasma by the applied microwave pulses supports the mode-conversion echo model. (Diss. Abstr. Int., B)

57872 INCOHERENT SCATTERING OF RADIATION FROM A HIGH TEMPERATURE PLASMA. Sheffield, J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 14: No. 8, 783-91(Aug 1972).

The theory of incoherent scattering, which includes high-temperature correction terms to first order in (v/c), is reviewed. It is shown that application of the low-temperature theory in the measurement of the electron temperature can lead to significant overestimate of this quantity. (auth)

57873 WAVE PROPAGATION IN PLASMAS WITH FLUCTUATIONS. Salat, A. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 14: No. 8, 805-24(Aug 1972).

A theory is presented that generalizes and corrects previous theories on wave propagation in fully ionized unmagnetized plasmas with fluctuations. A unified treatment is given both for microscopic density fluctuations due to the discrete particle structure and for macroscopic fluctuations. Longitudinal and transverse scattered waves, i.e., Coulomb collisions and "scattering", are included. A general plasma conductivity as a function of the frequency and the wave number of the wave is derived for the case that the phase velocity is much larger than the thermal velocities. In a simple example the relative significance of microscopic and macroscopic fluctuations are discussed in detail. (auth)

57874 LOW FREQUENCY ELECTROSTATIC WAVES IN A TURBULENT PLASMA. Dobrowolny, M. (European Space Research Inst., Frascati, Italy). Plasma Phys.; 14: No. 9, 825-47(Sep 1972).

A procedure was developed to study electrostatic dispersion properties of a turbulent, low-β, inhomogeneous, collisionless plasma. The formalism was applied to study the effect of an ion acoustic turbulence parallel to the magnetic lines of force on the dynamics of low-frequency waves (frequencies below the ion cyclotron frequency) of the drift type. It is found that even weak turbulence can modify significantly the drift-wave dispersion properties. In particular, some well-known drift instabilities can become dynamically stabilized, while new instabilities, driven by the turbulence, are found. A detailed discussion of such possibilities is given in the two regimes in which the phase velocity of the low-frequency wave parallel to magnetic lines is either above the electron thermal speed, or between the ion and electron thermal speeds. (auth)

57875 DISPERSIVE WAVES IN A SLIGHTLY IONIZED NONEQUILIBRIUM PLASMA. Harstad, K. G. (California Inst. of Tech., Pasadena). Plasma Phys.; 14: No. 9, 857-85 (Sep 1972).

The equations giving the response of a slightly ionized plasma with monatomic components to sinusoidal perturbations are formulated. Included in the model equations are the electron Hall effect, electron thermal diffusion, radiation, and electron—atom rate processes. Plasma conditions are limited to those where viscous effects, the induced magnetic field, ion slip, and atom—atom inelastic processes can be neglected. The limiting cases of frozen and equilibrium electron excited-state populations are discussed. Results are presented of calculations for MHD generators with a working fluid of potassium-seeded argon and with a Boltzmann distribution of electron quantum states of the seed in steady state. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 56161, 56181, 56419, 57166, and 57940.

57876 (DP–1304) EGAD: A COMPUTER PROGRAM TO COMPUTE DOSE INTEGRALS FROM EXTERNAL GAMMA EMITTERS. Cooper, R. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Sep 1972. Contract AT-(07-2)-1. 28p. Dep. NTIS.

EGAD is an external gamma dose code programmed in FORTRAN IV that provides an estimate of whole-body gamma dose resulting from radioactivity released to the environs. To model average exposure over long time periods, the distribution of material is assumed to be Gaussian about a given release height in the vertical direction with a homogeneous distribution in the crosswind direction. The code provides output in the form of dose integrals that are functions of the vertical dispersion parameter σ_z, release height, inversion lid, and gamma energy. The calculated integrals are independent of the source, radioactive decay, wind speed, and sector width. In the Savannah River man-rem evaluation program, gamma dose may be calculated at a rate of >20,000 individual cases per second on the IBM 360/65, including processing time for the meteorological data involved. (auth)

57877 (EUR–4810(Vol.2)) THIRD SYMPOSIUM ON MICRODOSIMETRY, STRESA (ITALY), OCTOBER 18–22, 1971. Ebert, H. G. (ed.) (European Communities, Luxembourg. Commission). Feb 1972. 463p. (In several languages). (CONF-711028–(Vol.2)). EUR FB 1,000.

A separate abstract was prepared for each of the 23 papers. (M.O.W.)

For abstracts of individual papers see: 56161–56163, 56215–56218, 56370, and 57878–57892.

57878 (EUR–4810(Vol.2), pp 471-82) MEASUREMENT OF EVENT SPECTRA FROM 250-kVp X RAYS, ^{60}Co GAMMA RAYS, AND TRITIUM BETA RAYS USING A GRID-WALLED PROPORTIONAL COUNTER. Ellett, William H. (Twinbrook Research Lab., Rockville, Md.); Braby, Leslie A.

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Energy deposition by photons and tritium beta rays has been studied using the microdosimetric techniques developed by Rossi. Spherical tissue equivalent volumes ranging in diameter from about 50 to $550 \mu g/cm^2$ were simulated by means of a grid-walled proportional counter and the energy deposition spectra compared to similar measurements made with a walled counter. Simultaneous events occurring in the walled counter caused significant perturbation of the event spectra produced by photons; such perturbations being greatest for heavily filtered 250-kVp radiation. The event spectra from tritium beta rays when compared with those made by cobalt-60 gamma rays and 250-kVp x rays indicate that energy deposition by tritium beta rays occurs in a much narrower range of event sizes and that the fraction of the dose delivered by events larger than 1 keV per micron is significantly larger for tritium beta rays. However, the maximum event size from tritium beta rays is about the same as for 250-kVp x rays. Over the range of site sizes studied, no large events, comparable to those produced by neutrons, were observed. (auth)

57879 (EUR–4810(Vol.2), pp 483-96) DOSE AVERAGE EVENT SIZE DETERMINATION FOR ^{60}Co USING PRECISION MEASUREMENTS OF IONIZATION CURRENT. Bengtsson, L. Gunnar (National Inst. of Radiation Protection, Stockholm).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The charge obtained from integration of ionization current during a certain time is the result of a finite number of interaction processes in the ionization chamber. Stochastic fluctuations in these processes will cause variations in the charge measured under otherwise constant conditions. In most measurements of x- and gamma rays, these variations are negligible compared with other measurement errors. In very precise measurements, however, the variations may be significant, for instance in standardization work. The high precision required in such work has resulted in equipment which is precise enough to be utilized for measurements aimed at finding the magnitude of the variations. It can be shown that the variance is simply related to the microdosimetry concept of dose average event size. Experiments were performed to measure the variance using a fast high-precision measurement system which automatically makes repeated integrations of ionization current. The relative standard deviation of a single measurement could be determined to a sufficient accuracy in the range from 0.1 to 0.01% using repeated measurements of 10 seconds duration. The dose average event size was determined for spherical volumes having unit-density equivalent diameters from 20 μm to 1 μm. The preliminary results given differ very significantly from earlier reported results obtained through the use of pulse-height-analysis techniques. The method employed should be useful for checking proportional chamber results and can be employed with chambers that can not be made to operate in the proportional chamber region. (auth)

57880 (EUR–4810(Vol.2), pp 497-510) EVENT FREQUENCY IN SMALL CYLINDERS EXPOSED TO γ RAYS. Srdoc, Dusan (Institut Rudjer Boskovic, Zagreb); Kellerer, Albrecht M.

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Event frequencies in microscopic cellular regions exposed to x-rays, γ-rays, and to fast electrons are utilized in various lines of radiobiological reasoning. For spherical regions of diameters up to about 0.1 μm diameter these frequencies, Φ, can be obtained according to the associated volume method of LEA. For diameters larger than 0.5 μm they can be and have been measured with the commonly employed Rossi counters. However, in the region between 0.1 μm and 0.5 μm, one encounters difficulties both in the experimental and in the theoretical determination of the quantity Φ. An attempt is described to bridge this gap. Experimental data are reported for cylindrical proportional counters of diameter between 0.1 to 10 μm. The observed frequencies of ionizing events are compared to theoretical results. The influence of such factors as energy loss straggling, LET-distribution, and variation of traversal length through the reference region is discussed. (auth)

57881 (EUR–4810(Vol.2), pp 511-28) MONTE CARLO CALCULATION OF SINGLE EVENT SPECTRA OF FAST NEUTRONS. Oldenburg, U.; Booz, J. (EURATOM, Ispra, Italy).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Neutron-produced single-event spectra for spherical volumes (effective diameters: 1.0 and 6.5 μm) in soft tissue were calculated with a Monte Carlo program. The same event distributions were measured, simulating the tissue volumes by a proportional counter with tissue-equivalent walls (Rossi counter) which was filled with a tissue-equivalent gas mixture. The irradiation was made with monoenergetic fast neutrons. The neutron energy varied between 0.6 and 5.85 MeV. The correspondence between the calculated spectra and the measured ones is good for event sizes above 5 keV/μm. The spectra disagree in the region of smaller energy transfers. This is at least partially due to the fact that the gamma ray contamination of the neutron beam was not considered in the calculation. As a further result of the Monte Carlo method, it became possible to determine the single-event spectra produced by the different types of neutron-produced ionizing secondary particles. (auth)

57882 (EUR–4810(Vol.2), pp 529-48) ENERGY SPECTRA OF PHOTONS AND ELECTRONS IN AN INFINITE MEDIUM IRRADIATED BY MONOENERGETIC PHOTONS. Abillon, Eliane. (In French).

From third symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

In a medium irradiated by photons, the observed effects are ascribed to photons and electrons generated in this medium. Since the efficiency of these particles depends on their energy, it is necessary to know their energy distribution. The effect of the primary photon energy on: (1) the energy distribution of the photon flux, (2) the energy distribution of the electrons ejected by photons, and (3) the energy distribution of the electron flux was investigated. The calculations are made in an infinite medium with uniformly distributed photons, whose energy has been successively taken as 1 MeV, 500 keV, 100 keV, 50 keV, and 25 keV. The results are given for gaseous methane. (auth)

57883 (EUR–4810(Vol.2), pp 549-70) INFLUENCE OF SCATTERING MEDIA ON THE SPECTRUM OF FREE PARTICLES AND THE ENERGY LOSS IN THE VICINITY OF SEVERAL INTERFACES IRRADIATED BY A ^{60}Co SOURCE. Patau, Jean-Paul; Saint-Paul, Andre; Blanc, Daniel (Univ., Toulouse). (In French).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The penetration of photons and their secondary electrons in matter is simulated by the Monte Carlo method. Studies were made of the effects of the thickness and the nature of different scattering media situated on the two sides of the interface. Results were obtained on the evolution of the energy spectra and the directions of the photons and the electrons in the vicinity of the interface, as well as the distribution of the energy deposited in the medium. The calculations are applied to bilaminate graphite/copper and soft tissue/bony tissue systems; they can be extended to other types of interfaces and to other sources of irradiation. (13 figures, 5 tables) (tr-auth)

57884 (EUR–4810(Vol.2), pp 583-99) MEASUREMENT OF THE ENERGY SPECTRA OF PHOTONS AND ELECTRONS IN AN IRRADIATED MEDIUM. Senaux, Robert (CEN de Saclay, Gif-sur-Yvette, France). (In French).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The method of introducing a detector into the system for the purpose of making a perturbation measurement is discussed. Spectrometry with external and internal detectors is also described. Limitations of the experiments are discussed. (M.O.W.)

57885 (EUR–4810(Vol.2), pp 701-40) STUDY OF THE FUNDAMENTALS OF DOSIMETRY IN THE LIGHT OF A GENERAL THEORY OF THE EVOLUTION OF TRANSFORMATION SYSTEMS. Delattre, Pierre. (In French).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

It is shown that an abstract study of transformation systems shows some general properties, particularly topological and order ones, from which a critical study of the foundations of dosimetry can be made. The gross concept of energy, as well as derived quantities, which are basically used in dosimetry are shown not to be very well fitted for explaining phenomena observed at chemical or biological levels. If they sometimes can be used as guidelines for comparisons of not-too-different irradiations, they cannot generally be considered as relevant variables as soon as one wants to set up an explanatory and predictive theory of phenomena. (auth)

57886 (EUR–4810(Vol.2), pp 741-65) INTERPRETATION OF DOSIMETRY PARAMETERS AT THE ATOMIC AND MOLECULAR LEVEL. Abillon, Eliane. (In French).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

In an irradiated molecular system, various species are formed (excited atoms and molecules, ions ....). Each of these species takes a particular part in the evolution of the system and its density varies with time. This evolution is expressed for a simple system and the expressions of the dominants of the obtained species are compared with the expressions of absorbed energy dose, ionization dose, and ionization and excitation dose. Since among these functions the ones that depend on radiation are accessible from particle spectra, these latter turn out to be the recommended parameters. From these new parameters, it is possible to have access to the parameters now in use: the expressions of these latter (dose, kerma, LET ...) are determined from the former ones. The used formalism also permits detailing the EBR value and demonstrating that it generally depends on the dose. (auth)

57887 (EUR–4810(Vol.2), pp 767-87) EXPERIMENTAL FACTS IN FAVOR OF A NEW THEORY. Arnaud, Yves (CEN de Saclay, Gif-sur-Yvette, France). (In French).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

An experimental study of the relative biological efficiency (RBE) of fast neutrons shows that the RBE factor is a function of the dose for which it is established. The "RBE dose" cannot be used to predict effects. Microdosimetry does not give better results since the improvements it introduces do not allow for the interdependence of the biological and physical parameters of irradiation. A study of the relationship between effects and dose absorbed for very simple systems (enzyme macromolecules irradiated with monoenergetic radiation) shows that the enzyme activity passes through a maximum then decreases when the irradiation time at constant flux is prolonged. Structural and functional attachments on the enzyme (polyphenoloxidase, actomyosin) cannot be predicted a priori from a knowledge of the absorbed dose alone. There is no univocal relationship between dose and effect. These experimental facts cast doubt on the usefulness of conventional dosimetry but are perfectly explicable by the theory proposed, from which it is easy for example to infer the properties of RBE and to show its dependence on dose; it also underlines the no-specificity of the notion of total energy delivered to an irradiated system. (auth)

57888 (EUR–4810(Vol.2), pp 807-32) MICRODOSIMETRY AND ITS ALTERNATIVES. Kellerer, Albrecht M. (Columbia Univ., New York).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The relation of microdosimetry to LEA's associated volume method, to LET theory, and to the various modifications of these approaches is analyzed, and the alternative interpretations of microdosimetric quantities and functions are discussed. The argument underlying the derivation of interaction distances and the site diameters in the cell is examined, and possible lines of future development are considered. (auth)

57889 (EUR–4810(Vol.2), pp 833-55) SPECTRAL ENERGY TRANSFER OF IONS TO THIN LAYERS OF TISSUE-EQUIVALENT MATTER. Booz, J.; Giglio, C.; Waker, A.; Gaggero, G. (C.C.R., Ispra, Italy).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Experiments and Monte Carlo calculations on the energy transfer of monoenergetic ions to thin tissue-equivalent gas layers are described. The experimental studies were done with monoenergetic alpha particles of 0.27 to 5.3 MeV, and the calculation dealt with alpha particles of 3 to 5.3 MeV and some proton energies. The thickness of the gas layers was varied between 0.1 and 1.0 μ (experiment) and between 100 Å and 1.0 μ (calculation). Experimental and calculated spectra of energy absorption are compared to each other and also to the VAVILOV distribution. The dependence of the average energy absorption and its variance on the layer thickness is discussed. (auth)

57890 (EUR–4810(Vol.2), pp 857-72) LOCAL ENERGY DISTRIBUTIONS FOR α-PARTICLES OF DIFFERENT ENERGIES IN RELATION TO THE EVALUATION OF CRITICAL SIZES AND ENERGY REQUIREMENTS INVOLVED IN THE INDUCTION OF DAMAGE IN MAMMALIAN CELLS. Hogeweg, B.; Barendsen, G. W. (Radiobiological Inst., TNO, Rijswijk, Netherlands).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Event size spectra were measured with a tissue-equivalent proportional counter in which energy was deposited by α-particles from ^{210}Po. The energy of the particles entering the sensitive volume was varied by introducing absorbers between the source and the counter. Energy deposition patterns for α-particles having a mean energy loss per unit path length (LET_∞) in unit-density tissue of 110, 126, 148, 200, and 215 keV/μm respectively, were investigated in cylindrical volumes of various simulated tissue dimensions. These dimensions were simulated by variation of the gas pressure. The simulated volumes have dimensions corresponding to 5.6, 1.2, 0.63, 0.3, 0.15, and 0.075 μm in unit-density tissue, respectively. From a comparison of the measured physical data with cross sections for impairment of the reproductive capacity derived from survival curves for cultured cells of human kidney origin (T-1 cells), it can tentatively be deduced that the critical structure in the cell, in which a given minimum damage must be produced in order to cause impairment of the capacity for unlimited proliferation, has dimensions smaller than 0.07 μm. (auth)

57891 (EUR–4810(Vol.2), pp 873-87) HEAVY ION EVENT SPECTRA. Gross, W.; Rodgers, R. C. (Columbia Univ., New York).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

The distributions of energy deposited by a beam of protons in small spherical tissue-equivalent sites were determined using a wall-less proportional counter. The beam diameter was much smaller than the size of the site, and the distance from the beam to the center of the sphere was varied from zero up to several times the site radius. The site sizes simulated ranged from 0.17 to 1 μm, and the proton energies employed were 1.7, 2.8, and 4.0 MeV. The effect of energy transport by delta rays is observed and found to increase as the site size is decreased. When the beam is at large distances from the site, the number of delta rays entering is proportional to the solid angle, but the mean energy deposited by these secondary electrons remains relatively constant. This energy does decrease with increasing proton energy owing to the change of LET with delta-ray energy. As the site size decreases, the fraction of the dose contributed by protons which pass by, but not through, the site increases. (auth)

57892 (EUR–4810(Vol.2), pp 889-97) PATH LENGTH DISTRIBUTION IN TWIN VOLUMES IN RELATION TO MICRODOSIMETRIC STUDIES. Benstock, D. M. J.; Hodges, D. C.; Burlin, T. E. (Polytechnic of Central London).

From 3rd symposium on microdosimetry; Stresa, Italy (18 Oct 1971).

Calculated path-length distributions were obtained for a wide variety of sphere separations and for various limiting path lengths in the constraining sphere. Diagrams showing path-length distributions as a function of several variables are given. (M.O.W.)

57893 (ORP/CSD-72-1) ESTIMATES OF IONIZING RADIATION DOSES IN THE UNITED STATES, 1960-2000. Klement, Alfred W. Jr.; Miller, Carl R.; Minx, Ramon P.; Shleien, Bernard (Office of Radiation Programs, Rockville, Md. (USA). Div. of Criteria and Standards). Aug 1972. 180p. GPO $1.50.

Estimated whole-body doses from environmental radiation are summarized. Environmental radiation doses to the whole body are compared to radiation doses from other sources. The following are tabulated: natural internal radiation dose estimates for the bone marrow and the lung; fallout radiation doses to the lung, skin, thyroid, bone, and respiratory lymph nodes; doses to the same organs from fuel reprocessing activities; lung and skin doses from the worldwide distribution of ^{85}Kr; thyroid doses from activities at the Nevada Test Site and the Nuclear Rocket Development Station; and lung, bone, and thyroid doses around several Atomic Energy Commission facilities. Medical, occupational, and miscellaneous radiations are discussed and many estimates of these are tabulated. (M.H.R.)

57894 RADIATION QUALITY OF ^{252}Cf. Dicello, J. F.; Gross, W.; Kraljevic, U. (Columbia Univ., New York). Phys. Med. Biol.; 17: No. 3, 345-55(May 1972).

The radiation quality of ^{252}Cf was determined in a tissue-equivalent phantom for simulated sample sizes of 1 and 2 μm. The measurements were made with a 2.54-cm spherical proportional counter of tissue-equivalent plastic with a source-to-counter distance of 7.8 cm. Event spectra were obtained for lineal energy densities between 0.04 and 10^3 keV μm^{-1}. The distributions in both lineal energy density and LET are presented. The dose mean of the distribution in lineal energy density was 38 keV μm^{-1} for the 1 μm site and 34 keV μm^{-1} for the 2 μm site. Correspondingly, the dose mean values of the distribution in LET were 34 and 30 keV μm^{-1} respectively. A mean quality factor of about six for ^{252}Cf was obtained for the geometry used here. The absorbed dose rate per unit source mass was found to be 11 rad $s^{-1}g^{-1}$, in substantial agreement with most previous measurements, and the ratio of absorbed dose due to protons and other heavy particles to that of electrons was approximately 0.9. (auth)

57895 IONIZATION IN MICROSCOPIC VOLUMES IRRADIATED BY ENERGETIC PHOTONS. Braby, Leslie Alan. Corvallis, Oreg.; Oregon State Univ. (1972). 145p. University Microfilms Order No. 72-12,517.

Thesis.

The energy absorbed by microscopic volumes exposed to ionizing radiation is not well represented by the average dose due to the small number of discrete energy transfers involved. The energy deposited in a microscopic volume can be determined by measuring the ionization in a detector filled with gas at low pressure. A grid-walled spherical proportional counter suitable for making such measurements for photon irradiation is described and compared to a solid-walled counter. Measured ionization distributions are presented for ^{60}Co gamma irradiation, filtered and unfiltered 250-kVp x rays, and for 65-kVp x rays. Other distributions which may be of use in understanding radiation-damage models are calculated from these measured distributions. (Diss. Abstr. Int., B)

57896 ELECTRON ENERGY-LOSS SPECTRA OF ZnS, ZnSe, AND ZnTe. Hengehold, R. L. (Air Force Inst. of Tech., Wright-Patterson Air Force Base, Ohio); Pedrotti, F. L. Phys. Rev., B; 6: No. 8, 3026-31(15 Oct 1972).

A study was made of the electron energy-loss spectra of the three IIB-VIA compounds ZnS, ZnSe, and ZnTe. These spectra were obtained both by electron-reflection and electron-transmission techniques. The electron-reflection measurements were made from freshly cleaved single-crystal surfaces of all three compounds in an ultrahigh-vacuum atmosphere. Changes in these spectra were observed as the surface was slowly contaminated. The electron-transmission measurements were made only on ZnTe using flash-evaporated thin films. The quality of these films was established by means of x-ray-diffraction, optical-reflectivity, and optical-absorption measurements. The peaks were interpreted in terms of interband transitions, surface plasmons, and bulk plasmons. The results are compared with optical-reflectivity measurements and x-ray-induced electron-emission measurements. (auth)

57897 EFFECT OF THE IRRADIATION FIELD SIZE ON THE DEPTH DOSE WITH SHAPING DEVICES IN GAMMA THERAPY. Stavitskii, R. V.; Pasynkova, I. E. Med. Radiol.; 17: No. 6, 86-90(Jun 1972). (In Russian).

Calculated and experimental methods were compared relative to depth doses of γ radiation, allowing for changes in the beam dimensions and shaping devices (blocks, shields, etc), in remote gamma therapy. Correction coefficients obtained semi-empirically agreed quite well with experimental testing. (tr-auth)

57898 CALCULATION OF ISODOSE CURVES IN REMOTE GAMMA THERAPY. Galina, L. S. Med. Radiol.; 17: No. 6, 84-5(Jun 1972). (In Russian).

Formulas are proposed that are useful in constructing dose distribution curves for a given field in remote gamma therapy employing ^{60}Co. Calculated data are in good agreement with experimental. (tr-auth)

57899 DOSE DISTRIBUTIONS AROUND A ^{252}Cf NEEDLE. Colvett, R. D.; Rossi, H. H.; Krishnaswamy, V. (Columbia Univ., New York). Phys. Med. Biol.; 17: No. 3, 356-64(May 1972).

Neutron and γ-ray absorbed-dose distributions near a ^{252}Cf needle source were measured in a large tissue-equivalent liquid phantom using very thin parallel plate, tissue-equivalent and aluminum gas multiplication ionization chambers. The results are in substantially better agreement with recently calculated values than with previously published measurements. (auth)

57900 ENERGY DEPENDENCE OF THE DIFFERENTIAL W-VALUE OF ALPHA PARTICLES IN TISSUE-EQUIVALENT GAS. Booz, J.; Smit, Th.; Waker, A. (Joint Nuclear Research Center, Ispra, Italy). Phys. Med. Biol.; 17: No. 4, 477-85(Jul 1972).

The linear ion density of α particles of energies 0.27 to 5.3 MeV was measured in tissue-equivalent gas. The results were compared with experimental and theoretical mass stopping powers in order to evaluate the differential W value (average energy per ion pair), of α particles, W_α. Above 1.6 MeV, W_α was within 3% agreement with W_∞, the constant W value of electrons. For low energies it was found that $W_\alpha > W_\infty$; however, a precise determination of W_α was not possible due to the uncertainties of the known mass stopping powers in this region. (auth)

57901 CALCULATED NEUTRON DOSE RATES FOR IMPLANTABLE ^{252}Cf SOURCES. Windham, J. P.; Shapiro, A.; Kereiakes, J. G. (Univ. of Cincinnati). Phys. Med. Biol.; 17: No. 4, 493-502(Jul 1972).

Fast neutron absorbed dose rates near ^{252}Cf finite line sources in several infinite tissue compositions were calculated. The neutron flux produced by a point source was calculated using the one-dimensional energy-dependent discrete ordinates computer code, DTF-IV. The calculations utilized an S-16 angular quadrature approximation, 21 energy groups and anisotropic scattering up to the third order in the cosine of the scattering angle. The kerma from a point source was obtained from the flux, using recently calculated kerma-fluence factors. The absorbed dose rates for line sources were obtained by using the point source kerma as a kernel and integrating over the length of the source, assuming charged-particle equilibrium. The calculated values agreed, to within a few percent, with recent measurements made at Brookhaven National Laboratory and recent Monte Carlo calculations. In addition to dose rate, the neutron flux spectrum at various distances along the perpendicular bisector of a line source is given. (auth)

57902 MASS ATTENUATION AND MASS ENERGY ABSORPTION COEFFICIENTS FOR LiF AND $Li_2B_4O_7$ FOR PHOTONS FROM 1 TO 150 keV. Greening, J. R.; Law, J.; Redpath, A. T. (Univ. of Edinburgh). Phys. Med. Biol.; 17: No. 4, 585-7(Jul 1972).

A table is presented of values of mass attenuation and mass energy absorption coefficients of LiF and $Li_2B_4O_7$, over a photon energy range of 1 to 150 keV. The values were calculated on the same basis and assumptions as the ICRU (1970) values. (UK)

57903 DOSE RATE OF γ RADIATION AT THE BOUNDARY OF A SEMI-INFINITE, AND INSIDE AN INFINITE, EMITTING MEDIUM. Vasil'ev, M. B. At. Energ. (USSR); 33: No. 2, 707-9(Aug 1972). (In Russian)

The dose rate of gamma radiation in an infinite radiating medium is expressed by an equation, allowing for self-absorption and multiple scattering. By way of example, this equation is modified to represent an infinite uranium ore, and then further developed to simulate a semi-infinite medium with a detector located at its boundary. Calculations and experiments were conducted to realize the accumulated dose for a point isotropic source and semi-infinite media consisting of H_2O, Al, and Fe, respectively. (K.S.W.)

57904 BREMSSTRAHLUNG ATTENUATION MEASUREMENTS IN ILMENITE LOADED CONCRETES. Lokan, K. H. (National Research Council of Canada, Ottawa); Sherman, N. K.; Gellie, R. W.; (and others). Health Phys.; 23: No. 2, 193-9(Aug 1972).

Experimental attenuation curves were obtained for uncollimated bremsstrahlung radiation, incident on ilmenite-loaded concretes of densities 180, 240 and 270 lb/ft^3. Measurements were made at bremsstrahlung end-point energies of 5, 10, 20, 30, and 40 MeV, at thicknesses increasing in steps of 3 in. from 0 to 30 in. It was found that, for all except the lowest energy, the bremsstrahlung weighted buildup factor was relatively small. Attenuation curves, calculated for a Schiff spectrum with a simplified photon-transport equation, in which all photons were assumed to be forward going, agree closely with the measurements for all except the 5-MeV case. (auth)

57905 CALCULATION OF THE DOSE, RADIONUCLIDE PRODUCTION, AND DELAYED PHOTON LEAKAGE DUE TO SOLAR-PROTON BOMBARDMENT OF TISSUE WITH POTENTIAL APPLICATION TO ASTRONAUT DOSIMETRY. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., Tenn.). Health Phys.; 23: No. 2, 159-67(Aug 1972).

Calculations were carried out to determine the dose (absorbed dose and dose equivalent), induced radionuclides and time-dependent photon-leakage spectrum due to solar-proton bombardment of a slab of tissue 30 cm thick. Proton spectra with characteristic rigidities of $P_0 = 50$, 100 and 200 MV were considered. The induced nucleon–meson cascade and the photon transport were calculated using Monte Carlo methods. The radionuclide production was determined by using calculated nucleon spectra and available production cross sections. The purpose of the calculations is to investigate the possibility of determining the whole-body dose received by astronauts in case of solar-flare exposure from measurement of the photons from the decay of radionuclides induced in the astronauts' bodies. (auth)

57906 COMPARISON OF MEASURED AND CALCULATED HIGH-LET NUCLEAR RECOIL PARTICLE EXPOSURE ON BIOSATELLITE 3. Benton, E. V.; Curtis, S. B.; Henke, R. P.; Tobias, C. A. (Univ. of California, Berkeley). Health Phys.; 23: No. 2, 149-57(Aug 1972).

High-LET nuclear recoil particles encountered during the flight of Biosatellite III were measured by means of a detector packet consisting of tissue-equivalent plastic nuclear track detectors located in the proximity of the animal's brain. The plastic detectors were used to record $Z \geq 2$, nuclear recoil particles, with trajectory lengths, $L_0 > 10\ \mu$. Some charge resolution, even for the very short track segments $\approx 10\ \mu$, was found possible. A heavy-recoil track density $\rho_R(Z > 2, L_0 > 10\ \mu) \approx 10^3$ cm^{-3} day^{-1} was measured. This value is in good agreement with a predicted density calculated with the assumption that the tracks are caused by nuclear recoils produced through the inelastic scattering of the trapped protons. The measured results probably correspond only to the high-energy tail of the total recoil-track distribution. (auth) (UK)

57907 LOW-ENERGY COMPONENT OF THE SPECTRUM OF THE ELECTRON RADIATION FIELD NEAR THE EXTRAPOLATED RANGE. Gusev, E. A.; Evstigneev, V. V.; Boiko, V. I. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 122-4(1972). (In Russian).

The spectral characteristics of the field of electron radiation behind thick absorbers was investigated through a study of the energy distribution of electrons behind thick slabs of C, Mg, and Pb. The initial energies of the beams were 9.85 and 2.95 MeV. The intensity of the low-energy component of the energy distribution of electrons was measured as a function of absorber thickness and atomic number of the targets. (K.S.W.)

57908 EFFECT OF TARGET ABSORPTION ON THE ATTENUATION CHARACTERISTICS OF BREMSSTRAHLUNG GENERATED AT CONSTANT MEDIUM POTENTIALS. Soole, B. W. (Admiralty Research Lab., Teddington, Eng.). J. Phys., B (London); 5: No. 8, 1583-95(Aug 1972).

General expressions for the spectral distribution and the attenuation of the intensity and exposure-rate of bremsstrahlung generated in a thick plane absorbing target by electrons of constant medium energy are derived in terms of the intensity–photon energy distribution of the radiation at its point of origin, on the assumption that electron penetration of the target is given by the Thomson–Whiddington relation. Comparison of computed exposure-rate attenuation curves with published experimental results shows that agreement is sensitive to the form assumed for the variation with bremsstrahlung energy of the coefficient B of the differential radiative cross section of the target nucleus, and that significantly better agreement is obtained when this is assumed to decrease with increasing photon energy, rather than remain constant, in general agreement with the predictions of Bethe and Heitler. It is concluded that the reasonable agreement shown with the results of computations based upon the Kulenkampff–Kramers expression for radiation intensity leaving the target is fortuitous, being the result of the near-cancellation of errors arising from (i) the neglect of target absorption, and (ii) the assumption of a constant value for B. The greater penetration of radiation resulting from the latter assumption is similar to that which actually occurs as a consequence of preferential absorption of the less energetic radiation by the target material. (auth)

57909 DOSE RATE OF CYCLOTRON-PRODUCED FAST NEUTRON BEAMS. Parnell, C. J.; Oliver, G. D.; Almond, P. R.; Smathers, J. B. (Hammersmith Hospital, London). Phys. Med. Biol.; 17: No. 3, 429-30(May 1972).

The bombardment of a beryllium target with 30-MeV deuterons accelerated in a cyclotron was the basis of an investigation of fast neutron dose rates of interest in radiotherapy. Dose rate over a range of 0 to 20 rad min^{-1} μ A^{-1} increased ~ as the 2.7 power of the deuteron energy over the range 8 to 60 MeV. (UK)

57910 UEBERSICHTSBEITRAEGE ZUR GASDYNAMIK. (Summaries of Contributions on Gas Dynamics). Leiter, E.; Zierep, J. (eds.). Vienna; Springer-Verlag (1971). 391p. $40.70.

A separate abstract was prepared for each of two of the ten reviews; the other eight were not in scope for NSA. (L.M.T.)

For abstracts of individual papers see: 57142 and 57911.

57911 SOME RECENT ADVANCES IN RADIATION GAS-DYNAMICS. Ryhming, I. L. pp 295-321 of Uebersichtsbeitraege zur Gasdynamik. /Leiter, E. (ed.). Vienna; Springer-Verlag (1971).

This partial review of the literature of this rapidly developing subject in such areas as astrophysics, reentry physics, and chemical physics concentrates first on monatomic gases, then on molecular gases. One particular problem emphasized is the structure of normal shock waves in such gases. Special attention is given to the various gas models resulting from an idealization of the real microscopic physical processes in the gases. In some instances, results predicted by the models are compared with experimental results; however, the analyses are, in many instances, of exploratory nature, and the full and detailed microscopic consequences of the models have not been assessed. (61 references) (L.M.T.)

57912 ENERGY LOSS AND STRAGGLING OF ALPHA PARTICLES IN ARGON. Haque, A. K. M. M.; Hora, R. M. (Polytechnic of the South Bank, London). Nucl. Instrum. Methods; 104: No. 1, 77-83(1972).

Energy loss and straggling of 6.05- and 8.78-MeV alpha particles were studied in pure argon with a silicon surface barrier detector; the effects of the detector window, source thickness, etc., on the resolution and the calibration of the system (keV per channel) were investigated in detail. In the case of low energy loss, the experimental results are compared with the theoretical Vavilov distribution; for high energy loss, agreement with the theory of Tschalär is discussed. The stopping cross section of argon, deduced from the experimental dE/dx values, compared with the existing results and discussed in the light of the theories of Bonderup and Lindhard and Winter. Finally, L(x)'s as defined by Lindhard and co-workers are calculated and compared with the universal dependence proposed; from the present experimental results the mean excitation potential, I, for argon is found to be 180 eV. (14 figures) (auth)

57913 STUDY OF THE DOSE COMPOSITION IN TISSUE-EQUIVALENT PHANTOMS FOR HIGH-ENERGY PROTONS. Dudkin, V. E.; Kovalev, E. E.; Smirenny, L. N.; Yakovlev, R. M. (Inst. of Medical and Biological Problem, Moscow). Health Phys.; 23: No. 5, 663-9(Nov 1972).

A study of the composition of the absorbed dose and dose equivalent was carried out in a 30-cm-thick slab of tissue-equivalent phantom. The doses for high-energy protons of up to 660 MeV in the phantom were calculated on the basis of measured double differential cross sections of proton interactions with light nuclei. A considerable contribution of secondary radiation to the total dose for high-energy protons ($E_p > 250$ MeV) was noted. The calculated data appeared to be in good agreement with the results of the direct measurement of doses in the phantom made with the ionization chamber. The difference between the method of calculation used and that of Zerby and Kinney (Nucl. Instrum. Meth., 36: 125(1965)) is pointed out. (auth)

57914 ENERGY LOSS OF ALPHA PARTICLES IN TISSUE EQUIVALENT PLASTIC. Walsh, P. J.; Pendergrass, F. (National Inst. of Environmental Health Sciences, Research Triangle Park, N. C.). Health Phys.; 23: No. 5, 701-4(Nov 1972).

The energy loss of alpha particles in tissue-equivalent plastic (TEP) was measured over an alpha energy range of 1 to 5.476 MeV. The results were compared with previous calculations of the energy loss of alpha particles in a tissue-equivalent gas. The technique used for preparation of thin films of TEP and the method used to determine the energy loss of alphas in the TEP are outlined. (auth)

57915 HEAT DEFECT OF LOW ENERGY X-RAYS ABSORBED IN TISSUE-EQUIVALENT PLASTIC. Saebel, M.; Schmidt, T.; Pauly, H. (Univ., Erlangen, Ger.). Health Phys.; 23: No. 5, 744-6(Nov 1972).

Measurements of the heat defect of a Shonka-type tissue-equivalent muscle blend, which is an electrically conducting mixture of 13.5% carbon, 52.1% polyethylene, 28.2 nylon, 2.2% silica and 4% calcium fluoride (by weights) were carried out with a 30-kV x-ray beam (1 to 30 keV/μ) from a beryllium window tube. Combining these results with those of Fleming and Glass (Radiat. Res., 37: 316(1969)) using monoenergetic 1.7-MeV protons (20 to 100 keV/μ) it is shown that the heat defect of Shonka plastic is not very dependent on LET and accumulated dose. (UK)

57916 PAIR PRODUCTION CROSS SECTION IN LEAD. Chisholm, A.; Nicholson, J. P. (Univ. of Liverpool, Eng.). J. Phys., A (London); 5: No. 9, 1404-8(Sep 1972).

The total cross section for the scattering of 40- to 120-MeV photons in lead was measured. The small difference between the measurements and the calculated values is interpreted as a shortcoming in the calculation of the pair production cross section. (auth)

57917 FILM-THERMOLUMINESCENT DOSIMETRY METHOD FOR PREDICTING BODY DOSES DUE TO DIAGNOSTIC RADIOGRAPHY. Vacirca, S. J. (State Univ. of New York, Brooklyn); Thompson, D. L.; Pasternack, B. S.; Blatz, H. Phys. Med. Biol.; 17: No. 1, 71-80(Jan 1972).

A technique for obtaining a continuous dose distribution in a phantom exposed to x rays was developed and applied to assess the dose in man resulting from radiographic examinations. Film packets and LiF thermoluminescent microdosemeters were sandwiched between the transverse sections of a phantom and exposed to typical diagnostic x-ray procedures. Information obtained from calibration graphs and from the air dose on the phantom surface at the center of the useful beam permitted the construction of isodose curves directly on film. The isodose curves were superimposed on drawings of the appropriate anatomical cross sections. When the drawings were arranged in proper sequence, a three-dimensional distribution was obtained. Dose assessments based on this distribution were compared with those obtained by other methods. The relative dose at specific point sites agreed well with data obtained by other investigators using miniature ionization chambers. For continuous dose distribution the method proved superior to other methods. (auth)

57918 CALCULATED DEPTH DOSE TABLES FOR ^{252}Cf SOURCES IN TISSUE. Krishnaswamy, V. (Univ. of Pennsylvania, Philadelphia). Phys. Med. Biol.; 17: No. 1, 56-63(Jan 1972).

Depth dose tables due to neutrons and γ radiation for ^{252}Cf sources of various designs currently available for use in radiotherapy are calculated. Tables are presented for 5 cm along the transverse axis and 5 cm along the source axis in steps of 0.5 cm. Gamma dose due to the primary γ rays includes a correction for the self-absorption in the Pt–Ir wire on which the ^{252}Cf is electrodeposited, in addition to the correction for absorption in the wall of the source. (auth)

57919 PENETRATION OF HIGH ENERGY ELECTRONS IN WATER. Van Dyk, J.; MacDonald, J. C. F. (Ontario Cancer Treatment and Research Foundation, London). Phys. Med. Biol.; 17: No. 1, 52-5(Jan 1972).

An experimental evaluation of the parameters involved in charge deposition from high-energy electron beams (10 to 32 MeV) in water is described, with particular reference to radiotherapy. Experimental and theoretical values of the parameters are compared, and a qualitative explanation of the differences is given. (auth)

Radiation Protection Standards

57920 COMMITTEE ON THE MEASUREMENT REFERENCE STANDARDS FOR IONIZING RADIATIONS. SECTION 2. RADIONUCLIDE MEASUREMENTS. Paris; Bureau International des Poids et Mesures (1972). 20p. (In French). Offilib, Paris.

The new committee structure is presented. The program proposed for Section II is given. The special problems to be studied are described: absolute (or exact) measurements, nuclear parameters, international comparisons, and miscellaneous problems. The organization of different research groups studying special problems is discussed, the plans adopted by these groups being represented. (France)

57921 PROCEEDINGS OF THE HOSPITAL PHYSICISTS ASSOCIATION. Cohen, M. (London Hospital). Phys. Med. Biol.; 17: No. 3, 431-6(May 1972).

A brief summary is presented of discussions held at a 1-day conference on electron dosimetry for radiotherapy. The following subjects were dealt with: (1) measurement systems, including the National Physical Laboratory FeSo$_4$ postal dosimetry service, ionization measurements, and thermoluminescent dosimetry; (2) practical problems of electron accelerators, with contributions from Manchester (MEL SL 75/10 linear accelerator), Glasgow (Vickers Series 3 Linac), Guildford (Brown Boveri Betatron, 35 MeV), and the M.E.L. Equipment Co. Ltd. (design of applicators for electron beam therapy); and (3) Low-energy (3 MeV) electrons. (UK)

57922 TISSUE-AIR RATIO, BACKSCATTER FACTOR, AND DEFINITION OF FIELD SIZE. Pfalzner, P. M. (Ontario Cancer Treatment and Research Foundation, Ottawa). Brit. J. Radiol.; 45: No. 537, 692(Sep 1972).

The relationship between tissue–air and backscatter factor is discussed. An inconsistency is shown to exist in this relation for megavoltage radiation. It is proposed that field size, with reference to depth dose and backscatter, should be defined at the peak build-up depth. This conceptual change leads to modified symmetrical equations relating tissue–air ratio, depth dose and backscatter factor. (auth)

57923 INTERCOMPARISONS OF ABSORBED DOSE AND DOSE DISTRIBUTION FOR X-IRRADIATIONS USING MAILED LiF THERMOLUMINESCENT DOSEMETERS. Puite, K. J.; Crebolder, D. L. J. M.; Hogeweg, B.; Broerse, J. J. (Instituut voor Toepassing van Atoomenergie in de Land Bouw, Wageningen, Netherlands). Phys. Med. Biol.; 17: No. 3, 390-9(May 1972).

Intercomparisons of absorbed doses and dose distributions for x rays with effective energies 80 to 130 keV, using mailed LiF thermoluminescent dosemeters, were carried out as a part of a cooperative programme of research in Europe on late effects of radiation. The studies demonstrated a number of discrepancies in the absolute dosimetry. In only six out of fourteen institutes did the absorbed dose agree to ±5% relative to the standard value; with regard to the dose distribution, in only five out of thirteen institutes were mice irradiations performed in conditions of uniform irradiation. It is pointed out that the results demonstrate the need for standardization of the x-ray dosimetry if a meaningful comparison of biological results is to be achieved. (auth)

57924 RADIATION LEVELS AND FLUENCE CONVERSION FACTORS. Neufeld, J.; Wright, H. (Oak Ridge National Lab., Tenn.). Health Phys.; 23: No. 2, 183-6(Aug 1972).

The Code of Federal Regulations defines a radiation area and high radiation area in terms of dose equivalent rate, but the manner in which dose equivalent rate is to be determined from measurements of the field is not prescribed. It is suggested in this investigation that radiation area and high radiation area be defined in terms of effective radiation level, which is the rate of change of the maximum dose equivalent in an anthropomorphic phantom placed in the radiation field. Conversion of physical data describing radiation into the effective radiation level is discussed, and the significance of normalization based on fluence and incident fluence is pointed out. (auth)

57925 CENTRAL AXIS TISSUE-AIR RATIOS AS A FUNCTION OF AREA/PERIMETER AT DEPTH AND THEIR APPLICABILITY TO IRREGULARLY SHAPED FIELDS. Wrede, D. E. (Univ. of Kentucky, Lexington). Phys. Med. Biol.; 17: No. 4, 548-54 (Jul 1972).

Families of central-axis tissue–air ratio (TAR) curves as a function of area at depth, divided by parameter (A/P) for fixed values of depth, were plotted and tabulated using the original data of Gupta and Cunningham for square fields. By means of an isodose plotter, values of TAR were experimentally obtained up to depths of 30 cm for mantle fields, and up to 10 cm for other irregularly shaped fields. These were compared with the tabulated values in order to evaluate the validity of square-field A/P's as a convenient parameter for the routine determination of central-axis TAR values. Rectangular, L, pentagonal, and special mantle shapes, which are all frequently encountered, were used. In all cases, the use of A/P as the determining criterion for values of TAR resulted in less than 3% difference from the tabulated square-field values. (auth)

57926 FUTURE OF PERSONNEL DOSIMETRY. Becker, K. (Oak Ridge National Lab., Tenn.). Health Phys.; 23: No. 5, 729-37(Nov 1972).

The present status of personnel dosimetry, which is still to a large extent characterized by inaccurate detectors and an oversimplified, uncritical interpretation of the results, leaves much to be desired. However, the current change in many installations to systems with increased reliability and more sophisticated methods of evaluation is an encouraging development. Some of the more basic aspects of personnel dosimetry are discussed briefly, and several changes in presently prevalent policies are suggested, such as: (a) completely different approaches with regard to detectors, monitoring periods, etc., for the large low-risk and the small high-risk groups of monitored persons; (b) establishing of minimum performance criteria for the dosimeters, in particular maximum permissible total errors as a function of dose, and regular testing of their performance; (c) more extensive use of appropriate correction factors for the interpretation of higher exposures; (d) careful adjustment of the dosimeter design to the particular monitoring situation; and (e) rapid replacement of film dosimeters by solid-state detectors, especially in warm and humid climates (developing countries). (auth)

Radiation Source Calibration and Standardization

57927 (CEA-N--1537) MEASUREMENT OF THE α PARTICLE FLUENCES OF TWO ^{238}Pu SOURCES. Perolat, Jean-Pierre; Gorry, Jeanne (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jun 1972. 12p. (In French). Dep. NTIS (U. S. Sales Only).

Two methods of measuring α-particle fluences, applicable to high-activity sources are described. They are both based on solid-angle techniques: a method enabling measurements of fluences up to 10^{10} α particles/m/2π to be made; and a more rapid measurement technique applicable over a more restricted range. The 6% accuracy obtained in this first stage of development can easily be improved upon. (France)

Shielding Calculations and Theory

Refer also to abstract 56818.

57928 ATTENUATION OF 15 MeV NEUTRONS IN MULTILAYER SHIELDS COMPOSED OF STEEL, POLYETHYLENE, AND BORATED MATERIALS. Maruyama, T.; Bouts, C. J. (TNO, Rijswijk, Netherlands). Phys. Med. Biol.; 17: No. 3, 420-4(May 1972).

Attenuation experiments were carried out, using a Van de Graaff accelerator (400 kV, 250 μA) to obtain monoenergetic neutrons of 15.6 MeV in the 0° direction from the ^{3}H(d,n)^{4}He reaction. Attenuation curves are presented and transmission values tabulated for steel, polyethylene, borated paraffin (3% boron) borated wood (3% boron), and multilayer shields of steel and polyethylene. It was concluded that steel was, per cm thickness, the most efficient for attenuation of 15 MeV neutrons, while polythene was the most effective for slowed down neutrons. (UK)

PHYSICS (SOLID-STATE)

Radiation Effects

Refer also to abstracts 56264, 56598, 56734, 56742, and 57166.

57929 (COO–3158-8) SOME PROBLEMS OF THE DETECTION OF SELF-INTERSTITIAL ATOMS IN FIELD ION MICROSCOPE IMAGES. Robinson, J. T.; Wilson, Kenneth L.; Seidman, David N. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). 25 Jul 1972. Contract AT(11-1)-3158. 26p. Dep. NTIS.

A pulse-field evaporation study was made of the field evaporation characteristics of atoms from the first five ledges of (011) planes of high-purity ($\leq 1.5 \times 10^{-6}$ at.fr. impurity level) tungsten of well-annealed specimens and specimens irradiated with 35- or 40-keV W^+ ions at room temperature (middle of Stage II) and $\sim 10^{-6}$ Torr. Examination of $>1.8 \times 10^4$ frames of ciné film of the well-annealed control specimens and $>2.6 \times 10^4$ frames of film of the irradiated specimens showed that the "bright spots" identified by Buswell as impurity-decorated vacancies were, in reality, tungsten atoms associated with the ledges of (011) planes. The identification of the "bright spots" as tungsten ledge atoms was achieved by employing a field-evaporation increment of $\sim 2.5 \times 10^{-3}$ of an (011) plane per evaporation pulse, as opposed to Buswell's increment of 1 to $1/8$ of an (011) plane per evaporation pulse. The concentrations of "bright spots" in the control and the irradiated specimens were almost identical to one another. The vacancy concentrations, as measured in 7 different families of high-index planes [{111}, {233}, {122}, {133}, {433}, {342}, and {532} planes] changed by a factor of 10^2 as a result of the irradiation. Hence, it was concluded that Buswell's model for the "bright spots" on the ledges of (011) plane is incorrect. An example was given of the field evaporation of a small vacancy cluster in a (011) terrace plane which gave rise to a double "bright spot" contrast effect. A hard-sphere ball model of a cluster of three vacancies in an (011) terrace showed that these "bright spots" were the by-product of the field evaporation process. Thus, this type of contrast effect must be taken into account when analyzing ciné film of irradiated specimens. (auth)

57930 SELF-COMPENSATION AND INTERACTION OF Li WITH THERMAL- AND RADIATION-INDUCED DEFECTS IN CdTe. Desnica, U. V.; Urli, N. B. (Rudjer Boskovic Inst., Zagreb). Phys. Rev., B; 6: No. 8, 3044-53(15 Oct 1972).

Lithium was introduced into CdTe by diffusion at three different temperatures (600, 680, and 750°C) under corresponding cadmium overpressures. Resistivity and Hall-effect measurements were used in monitoring the stability and modification of various defects connected with the presence of lithium immediately after diffusion as well as after aging for more than a year at room temperature. Two levels at $E_v + 0.14$ eV and $E_v + 0.27$ eV were found in lithium-doped p-type CdTe. Several samples were also irradiated by ^{60}Co γ rays and results compared with those obtained by annealing at higher temperatures. A model of self-compensation by amphoteric action of lithium was proposed in CdTe containing lithium in higher concentrations. The apparently inconsistent results of various authors on the observed energy levels attributed to lithium in CdTe were explained by a tendency of lithium to modify only ionization energies of defects present in the lattice. (auth)

57931 POSITRON ANNIHILATION. Merrigan, Joseph A. (Eastman Kodak Co., Rochester, N. Y.); Green, James H.; Tao, Shu-jen. pp 501-86 of Physical Methods of Chemistry. Pt. IIID. /Weissberger, Arnold (ed.). New York; John Wiley and Sons, Inc. (1972).

After briefly discussing the history of the discovery of the positron and proof of the existence of positronium, fundamental considerations of the two are presented. Experimental techniques are reviewed under the following headings: positron sources; energy spectra of annihilation photons (observation of positronium and measurement of electron—positron pair momentum); lifetime technique; two- and three-photon coincidences; angular correlation; and multiparameter methods. Methods of data analysis described include the lifetime technique and angular correlation. Positron and positronium decay in the following are discussed: gases; liquids (organic and aqueous); and solids (organic, inorganic, polymers, and metals. A final section is devoted to theoretical interpretations. (10 tables, 34 figures, 227 references). (L.M.T.)

57932 EFFECT OF INCREASING BEAM VOLTAGE ON THE INTERNAL QUANTUM EFFICIENCY OF SPONTANEOUS EMISSION IN ELECTRON-BEAM-EXCITED p-TYPE GaAs. Radkshit, S.; Biswas, S. N.; Chakravarti, A. N. (Univ. of Calcutta). Int. J. Electron.; 33: No. 3, 353-6(Sep 1972).

The dependence of the internal quantum efficiency of spontaneous emission on the beam voltage in electron-beam-excited p-type GaAs is theoretically determined. The procedure of determination is justified through reasonable agreement of the quantum efficiencies estimated for a beam voltage of 15 kV at 77 and 300°K with those determined experimentally. (auth)

57933 EFFECT OF HEAVY NEUTRON IRRADIATION ON THE ELECTRICAL RESISTIVITY OF DIAMOND. Vance, E. R.; Milledge, H. J.; Collins, A. T. (University Coll., London). J. Phys., D (London); 5: No. 5, L40-L2(May 1972).

Neutron irradiation lowers the resistivity of diamonds to about 0.3 Ω-cm after very heavy doses. (auth)

57934 ACCUMULATION OF F-CENTERS IN KCl–Pb CRYSTALS GROWN FROM AQUEOUS SOLUTIONS. Kravchenko, N. S.; Grigoruk, L. V.; Melik-Gaikazyan, I. Ya. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 169-72(1972). (In Russian).

The kinetics of accumulation of F centers under the action of x rays were compared in crystals of KCl and KCl : Pb of two types (grown from aqueous solutions and grown from melts by Kiropulos's method). The dependence of F-center concentration on dose or irradiation time was resolved into two steps: a "fast" stage that assured an accumulation of 10^{17} cm^{-3}, and a "slow" stage producing 10^{19} cm^{-3}. (K.S.W.)

57935 PHOTOCONDUCTIVITY OF GALLIUM ARSENIDE IRRADIATED WITH 5 MeV PROTONS. Krivov, M. A.; Red'ko, V. P.; Ramazanov, P. E.; Pyatkov, A. G. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 34-40(1972). (In Russian).

The photoconductivity spectrum of GaAs revealed a series of levels before and after irradiation with 5-MeV protons. The majority of the levels discovered after irradiation is associated with uncontrolled but activated (by radiation) impurities, e.g., GaAs : Cu exhibited a special activation. A decrease in absolute photoconductivity during irradiation derives from an emergence of recombination centers. The average energy of activation of these centers was estimated to be 0.06 eV. The recombination centers were identified as lattice defects. (tr-auth)

57936 ELECTRICAL RESISTIVITY INCREASE DURING ANNEALING OF COLD-WORKED OR IRRADIATED NIOBIUM. Eto, Motokuni (Japan Atomic Energy Research Inst., Tokai). Trans. Jap. Inst. Metals; 13: No. 4, 294-5(Jul 1972).

An investigation was conducted to determine whether the behavior of low-temperature recovery of irradiated or deformed Nb is affected by impurity atoms. Data are included which indicate that recovery is related to the interaction between point defects and impurity atoms. Electric resistivity was found to increase with increased interstitial impurity atoms. (J.R.D.)

57937 NEW COLOUR CENTRE IN CALCIUM OXIDE: POSSIBLE IDENTIFICATION OF THE F_A^+ CENTRE. Hughes, A. E.; Pells, G. P. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London); 5: No. 17, 2543-52(5 Sep 1972).

A new color center was observed in neutron-irradiated crystals of calcium oxide doped with magnesium. It has an absorption band peaking at 374 nm and a complementary emission band at 398 nm. A zero-phonon line appears at 384.5 nm in absorption and emission. The value of the Huang—Rhys factor for both bands is $S \simeq 4$. The defect cannot be detected in absorption in irradiated pure crystals, but the zero-phonon line was detected weakly in emission. The line is shifted to the blue and broadened in the doped crystals compared with the pure crystals. A similar shift and broadening occurs for the F^+ center zero-phonon line. These effects can be understood in terms of internal strains caused by the magnesium impurities. Uniaxial stress experiments show that the new center has tetragonal symmetry, the absorption and emission bands having electrical dipole transition moments parallel to the fourfold axis. It is proposed that this defect is an F_A^+ center, an interpretation supported by a comparison of its properties with those of the F^+ center. (auth)

57938 EFFECT OF NITROGEN IMPURITY ON THE ANNEALING OF RADIATION DAMAGE IN DIAMOND. Davies, G. (King's Coll., London). J. Phys., C (London); 5: No. 17, 2534-42(5 Sep 1972).

Impurity nitrogen in type Ia diamond is known to trap radiation-damage centers during annealing. Most of the nitrogen is also known to be present in two forms, labeled A and B, from the absorption peaks produced by them in the range 100 to 1332 cm^{-1}. The effect of these different forms of nitrogen on the annealing of radiation damage is considered. The visible absorption spectra of 41 annealed diamonds were compared with their infrared spectra. The results suggest that the A form of nitrogen produces the 2.463-eV center, while the B form gives the 2.499-eV center, by trapping a radiation-damage center during annealing. The trapping centers compete with each other for the damage centers. In nature type Ib diamond (containing paramagnetic nitrogen), the 640-nm (1.945-eV) centre is produced by the annealing, in agreement with du Preez (1965). (auth)

57939 CHANGE IN THE ELECTRICAL RESISTANCE OF ORDERED ALLOYS DURING IRRADIATION BY ELECTRONS. Platov, Yu. M.; Bystrov, L. N.; Sadykhov, S. I. O. Izv. Akad. Nauk SSSR, Metal.; No. 2, 101-5(1972). (In Russian).

The kinetics of change in electrical resistance of the alloy Ag–8.75 at.% Zn during electron irradiation at about 145°K were studied. For comparison, two samples of the alloy were used that were characterized by different degrees of ordering. An anomalous change in resistance was observed during initial irradiation in an Ag–Zn sample with an increased density of dislocations. This anomaly could not be related to known mechanisms concerning electrical resistance of ordered alloys, but may be interpreted as a dislocation rearrangement in certain temperature regions. (K.S.W.)

57940 CHANNELLING EFFECTS ON THE TRANSMISSION OF MeV H_2^+ IONS THROUGH A THIN GOLD SINGLE CRYSTAL. Poizat, J. C.; Remillieux, J. (Univ., Lyon). J. Phys., B (London); 5: No. 5, L94-7(May 1972).

The transmission without dissociation of MeV H_2^+ ions through planar directions of a thin gold single crystal is studied. The results indicate that the channelling effects on the transmission yield are very important. (auth)

57941 RADIATION DAMAGE PROCESS IN MgF_2. Buckton, M. R.; Pooley, D. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London); 5: No. 13, 1553-62(10 Jul 1972).

F center production by ionizing radiation in MgF_2 has a character that changes markedly with temperature; below 50°K and above 200°K essentially unsaturating defect production occurs, while between 50 and 200°K the concentration of F centers quickly saturates. Detailed measurements of the effect of irradiation intensity at 5°K, 80°K, and 300°K were made, together with measurements at constant intensity as a function of temperature. These results are interpreted in terms of a model in which the radiation creates close pairs of F centers and H centers, which are stable at low temperatures, recombine at intermediate temperatures, and dissociate at high temperatures. Other evidence is presented for this model, including the fact that the observed F band is rather wider for F centers created at 5°K than for centers created at 300°K and measured at 5°K. (auth)

57942 ESR STUDY OF THE $H_A(Li^+)$ CENTER IN NaF. Plant, William James. Lafayette, Ind.; Purdue Univ. (1972). 110p. University Microfilms Order No. 72-21,254.

Thesis.

A new paramagnetic defect, designated as the $H_A(Li^+)$, was found in NaF : Li^+ bombarded with electrons at 6°K. This defect produces previously unobserved ESR lines. Analysis shows that the defect is an interstitial fluorine atom that has formed an F_2^- molecule ion with a lattice fluorine ion and has been stabilized by a Li^+ impurity ion. The molecular axis of the F_2^- molecule is oriented in a completely general direction in the lattice. The F_2^- molecule has a large hyperfine interaction with the nucleus of one nearest-neighbor fluorine ion. This interaction is sufficiently strong to produce line splitting in the ESR spectrum of the defect. The $H_A(Li^+)$ center is stable up to 215°K, although reorientation of the defect causes its ESR spectrum to disappear at about 20°K. Electron bombardment at 77°K was also found to produce this center. The ESR spectrum of NaF : Li^+ after this treatment, however, contains several unexplained lines in addition to those of the $H_A(Li^+)$ center. Since none of these lines appear in irradiated pure NaF, it appears that other lithium-associated defects are produced by irradiation at 77°K. (Diss. Abstr. Int., B)

Physical Properties

Refer also to abstracts 55907, 55908, 56676, 56704, 56705, 56710, 56715, 57493, and 57522.

57943 THOMAS–FERMI CALCULATION OF THE INTERLAYER FORCE IN GRAPHITE. Santos, Emilio; Villagra, Antonio (Univ., Valladolid, Spain). Phys. Rev., B; 6: No. 8, 3134-41(15 Oct 1972).

A model of a graphite crystal is proposed in which planar layers of positive charge are considered instead of the point charges of nuclei. The interlayer electronic density is calculated integrating both the Thomas–Fermi and the Thomas–Fermi–Dirac equations. From these densities, the total energy of the electrons is calculated including corrections for inhomogeneity in the form of Weizsäcker and Kirzhnits. The influence of the different corrections is studied with the result that the best method is to calculate the density from the Thomas–Fermi–Dirac equation and to take into account the inhomogeneity corrections in the form of Kirzhnits. (auth)

57944 CRITICAL PHENOMENA IN ALLOYS, MAGNETS, AND SUPERCONDUCTORS. Battelle Institute Materials Science Colloquia, Geneva and Gstaad, Switzerland, September 7–12, 1970. Mills, Roger E.; Ascher, Edgar; Jaffee, Robert I. (eds.). McGraw-Hill Series in Materials Science and Engineering. New York; McGraw-Hill Book Company (1971). 689p. $48.50. (CONF-700918).

Forty-one experimental and theoretical papers and associated discussions were presented on phenomena near continuous phase transitions. Comparisons are made with similar phenomena in fluids, ferroelectrics, and superconductors. The book is subdivided into six sections: Introductory Lectures, General Theory (thermodynamics, scaling, Ising systems, and field theory), Development of Spatial Ordering, Magnets and Superconductors, Transport Properties, and finally a summary agenda discussion. (D.L.C.)

57945 RIGHI–LEDUC EFFECT IN INDIUM. Stephan, C. H.; Maxfield, B. W. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., B; 6: No. 8, 2893-2900(15 Oct 1972).

Measurements of the magnetic field and temperature dependence of the Righi–Leduc coefficient were made in pure oriented single-crystal specimens of indium in the temperature range 3.5 to 8°K. The coefficient is observed to change from negative at low fields to positive at sufficiently large magnetic fields. The value of the crossing field, which is on the order of a few kG, increases with temperature. Analysis of the results in terms of a two-band model for the electronic carriers yields an estimate of about 1.2 for the ratio of electron-to-hole relaxation times. (auth)

57946 ALFVEN WAVE PROPAGATION AND DAMPING IN PYROLYTIC AND SINGLE-CRYSTAL GRAPHITE. Krauss, Alan Robert. Lafayette, Ind.; Purdue Univ. (1972). 187p. University Microfilms Order No. 72-21,221.

Thesis.

Alfvén wave propagation was studied in pyrolytic and single-crystal graphite by means of microwave re-reflection and transmission experiments in magnetic fields of ~1 to 20 kG at 4.2 and 77°K. In transmission, the amplitude and phase were measured independently, yielding values of the collision frequency and mass density parameter at 4.2°K that were in reasonable agreement with theoretical and previously reported experimental values, although there was some evidence that the collision frequency is magnetic-field-dependent. The highly anisotropic scattering rate reported by Spain was not observed. At 77°K, a slight increase was observed in the mass density, corresponding to nonparabolic energy band structure as predicted by the Slonczewski–Weiss model. In addition to Alfvén wave phenomena, oscillatory structure was observed in the reflection data for single-crystal samples which was periodic in $1/B_0$, the period corresponding to the Shubnikov–de Haas periods of the majority and minority carriers. Very pronounced oscillatory structure was observed in the damping data of the single-crystal transmission experiment. The oscillations were not, however, periodic in $1/B_0$. This structure is tentatively associated with Shubnikov–de Haas effects corresponding to both majority and minority carriers. A small, unidentified oscillation was observed in the phase data for the same sample. (Diss. Abstr. Int., B)

57947 ELECTRICAL RESISTANCE AND ENTHALPY OF MOLYBDENUM AND TUNGSTEN. Martynyuk, M. M.; Karimkhodzhaev, I. (Physical-Technical Inst., Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR; 15: No. 5, 21-5(1972). (In Russian).

The relative electrical resistance of Mo and W wires was studied as a function of their enthalpies by means of a pulse method, which consisted of rapid heating of the wire samples by a high-power pulse of current. Two types of apparatus were used in an attempt to obtain reliable data: a high-voltage source that provided 3,000 V and a low-voltage source at 300 V. These two electrical sources brought Mo and W wires up to their melting points in about 20 and 600 μsec, respectively. The results from the two types of sources were in good agreement. (K.S.W.)

57948 DIELECTRIC CONSTANT OF AN EXCHANGE-POLARIZED ELECTRON GAS AND THE METAL-SEMICONDUCTOR TRANSITION IN DOPED EuO. Leroux-Hugon, P. (Centre National de la Recherche Scientifique, Meudon, France). Phys. Rev. Lett.; 29: No. 14, 939-43(2 Oct 1972).

Calculations are reported of the linear responses (dielectric constant and magnetic susceptibility) of an electron gas interacting through an exchange interaction with a set of localized magnetic moments. This allows one to account for the metal-semiconductor transition that has been observed in moderately doped EuO, in agreement with experimental data. (auth)

57949 ELASTIC NEUTRON DIFFRACTION STUDY OF $TbAl_2$ AND $HoAl_2$. Millhouse, A. H.; Purwins, H.-G.; Walker, E. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). Solid State Commun.; 11: No. 5, 707-12 (1 Sep 1972).

Powder samples of $TbAl_2$ and $HoAl_2$ were studied by neutron diffraction for temperatures down to 4.2°K. It is found that both compounds are ferromagnetically ordered at 4.2°K. The form factor was measured between $\sin \theta/\lambda = 0.11$ and 0.55 $Å^{-1}$. Within the experimental error, agreement of the measured form factor with the free ion form factor was found. The magnetic moment of Tb in $TbAl_2$ is $9.2 \pm 0.2\mu_B$ and that of Ho in $HoAl_2$ is $8.1 \pm 0.2\ \mu_B$. (auth)

57950 MAGNETIC STRUCTURE OF TERBIUM OXIDE, TbO_2. Quezel-Ambrunaz, S.; Bertaut, E. F. (CEN, Grenoble, France). Solid State Commun.; 11: No. 5, 605-10(1 Sep 1972). (In French).

The magnetic structure of TbO_2 was investigated. Tb^{4+} has the electronic configuration of Gd^{3+} with $L = 0$, $S = \frac{7}{2}$. The compound is antiferromagnetic with a Néel temperature of 3°K. The spins are in the (111) plane, having an unknown direction. A magnetic moment of $6.25 \pm 0.1\ \mu_B$ was determined for Tb^{4+} at 1.5°K. (auth)

57951 ELECTRONIC SPECIFIC HEATS OF $CeNi_2$ AND $CeCo_2$. da Silva, J. M. M.; Hill, R. W. (Oxford Univ.). J. Phys., C (London); 5: No. 13, 1584-8(10 Jul 1972).

Measurements between 1 and 10°K show that $CeNi_2$ and $CeCo_2$ have large electronic specific heats: $\gamma = 24.9$ and 38.2 mJ $mole^{-1}$ K^{-2}, respectively. Possible origins of these large values are discussed. A small specific heat anomaly is found at 5.9°K in all specimens and is believed to be due to uncombined cerium, possibly in the cubic γ form. (auth)

57952 LOW TEMPERATURE SPECIFIC HEATS OF SOME LAVES PHASES CONTAINING NEODYMIUM. da Silva, J. M. M.; McDermott, J. M.; Hill, R. W. (Oxford Univ.). J. Phys., C (London); 5: No. 13, 1573-83(10 Jul 1972).

Specific heat measurements were made between 0.2 and 4°K on $NdNi_2$, $NdAl_2$, and $NdCo_2$, and also on $LaAl_2$. Hyperfine contributions were identified in the neodymium compounds and the ionic moments deduced, giving 1.6 μ_B, 2.39 μ_B, and 2.63 μ_B respectively. These moments, the known Curie temperatures, and paramagnetic susceptibilities, can all be interpreted in terms of a common model to represent crystal field and exchange effects. All three compounds have "electronic" specific heats which are far larger than the electronic specific heat of $LaAl_2$ ($\gamma = 12.1$ mJ $mole^{-1}$ K^{-2}). (auth)

57953 ANGULAR CORRELATIONS OF ANNIHILATED γ QUANTA DURING ANNIHILATION OF POSITRONS IN Pb—Sn ALLOYS AS A FUNCTION OF CONCENTRATION. Marinov, M. G.; Troev, T. D.; Dyakov, T. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 4, 455-7(1972). (In Russian).

The relative angular distribution of annihilated γ quanta for positron annihilation was studied in Pb—Sn alloys of the following compositions: 15% Sn, 33.3% Sn, 50% Sn, and 66.6% Sn. The effect of narrowing the half-width of the correlation curves of angular distribution was investigated as a function of alloy composition. The source of positrons was ^{64}Cu in the amount of a few hundreds of millicuries. Two separate graphs of momentum vs alloy concentration, and alloy melting point vs alloy concentration revealed minima at the same alloy concentration: Pb—66.6% Sn. (K.S.W.)

57954 TEMPERATURE DEPENDENCE OF THE MAGNETIC REFLEX WIDTH IN THE VICINITY OF NEEL'S TEMPERATURE IN Ho. Gogava, V. V.; Kernozhitskaya, E. A.; Kolesnikova, L. M.; Mandzhavidze, A. G. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 67: No. 3, 581-4(Sep 1972). (In Russian).

The temperature dependence of the magnetic reflex width was investigated at different deviations from the Bragg reflex near the helical antiferromagnetism—paramagnetism phase transition for Ho. The parameter of spin correlations was calculated from the data. (auth)

57955 POSSIBILITY OF A MAGNETIC TRANSITION IN Ce ALLOYS. Alascio, B. (Comision Nacional de Energia Atomica, San Carlos de Bariloche, Argentina); Lopez, A.; Olmedo, C. F. E. Solid State Commun.; 11: No. 4, 511-14(15 Aug 1972).

Divalent rare-earth impurities have a strong effect in lowering the $\alpha-\gamma$ transition temperature in Ce, allowing the γ phase to become stable at the low temperature without much change in its physical properties. Using the assumption that in this way an ordering (Néel) temperature can be reached, plus a thermodynamical analysis of the electronic transformation that takes place at the $\alpha-\gamma$ transition, a phase diagram for these alloys is predicted similar to that found in Cr-doped V_2O_3. (auth)

57956 MAGNETIC PROPERTIES OF RARE EARTH METALS. Elliott, R. J. (ed.). London; Plenum Press (1972). 425p.

The chapters are entitled: phenomenological theory of magnetic ordering, importance of interactions with the crystal lattice, magnetic structures of rare earth metals and alloys, bulk magnetic properties, spin waves, energy band structure, indirect exchange interactions and magnetic ordering, transport properties, and hyperfine interactions. (UK)

57957 THEORY OF A NONCOLLINEAR FERROMAGNETISM OF THE U_3X_4 COMPOUNDS. Przystawa, J.; Praveczki, E. (Joint Inst. for Nuclear Research, Dubna, USSR). J. Phys. Chem. Solids; 33: No. 10, 1943-51(Oct 1972).

In order to describe magnetic properties of U_3X_4 compounds, a model is proposed which contains, besides isotropic exchange, uniaxial exchange anisotropy and three-axial crystal field term. Semiclassical considerations lead to a noncollinear, three-axial, ground state configuration and stability conditions for such an ordering are found. The behavior of the system with the external magnetic field of different orientations is discussed at zero-temperature. There is no saturation in any direction and asymptotic formulas for magnetization at the high fields and for the initial susceptibility tensor are given. An expression for the Curie temperature is obtained in the simplest molecular field approximation. The model seems to explain qualitatively the experimental data. (auth)

57958 STUDY OF THE ELECTRONIC ENERGY BANDS FOR α AND γ CERIUM. Mukhopadhyay, G. (Tata Inst. of Fundamental Research, Bombay). J. Phys., F(London); 2: No. 3, 450-8(May 1972).

The results of the electronic energy band structures for α and γ cerium are reported. The exchange potential was parametrized and the energy bands computed following the augmented-plane-wave method. The position of the f band was found to be extremely sensitive to the value of the parameter. The remaining structure of the bands, however, is not as sensitive, and is discussed for different electronic configurations for the two phases of cerium. (auth)

57959 MAGNETIC MOMENT DISTRIBUTION IN URANIUM MONOSULPHIDE. Wedgwood, F. A. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London); 5: No. 17, 2427-44(5 Sep 1972).

Single crystals of cubic ferromagnetic uranium monosulphide were examined by polarized-neutron diffraction to yield accurate measurements of the magnetic scattering in forty-three non-equivalent Braff reflections. Together with magnetization data, these measurements show that the magnetic moment distribution in the crystal is associated primarily with the 5f shell of the uranium ion, and that there is a small negative moment on the 7s or 6d electrons of uranium and negligible moment on the sulfur ion. The observed magnetic scattering was compared with the value calculated for isolated uranium ions, and for uranium ions in a cubic crystal field, assuming one, two, three, or four 5f electrons. The best fit is given by a model for the uranium ion designated $5f^2$, $^3H_{41}$, in which the exchange field is of comparable magnitude to the crystal field giving an ordered magnetic moment of $1.7\mu_B$ per uranium atom. (auth)

57960 INTRINSIC MAGNETIC AFTEREFFECT IN $Dy(Co,Ni)_2$. Taylor, K. N. R.; Melville, D.; Primavesi, G. J. (Univ. of Durham, Eng.). J. Phys., F (London); 2: No. 3, 584-91 (May 1972).

A new type of time-dependent magnetization was found in the pseudobinary compound series $Dy(Co,Ni)_2$. This was associated with the narrow domain wall processes reported previously by several workers and is thought to be an intrinsic aftereffect associated with materials for which the ratio of the anisotropy and exchange energies is large. (auth)

57961 GIANT, DWARF, AND NEGATIVE MOMENTS OF SAMARIUM IN METALS. Stewart, A. M. (Univ., Genoa). J. Phys., F (London); 2: No. 3, L44-6(May 1972).

Attention is drawn to some unusual magnetic effects that may occur when samarium is dissolved in strongly paramagnetic metals. (auth)

57962 INDIRECT EXCHANGE FOR RARE EARTHS IN METALS. Campbell, I. A. (Paris Univ., Orsay, France). J. Phys., F (London); 2: No. 3, L47-50(May 1972).

It is suggested that the RKKY form of indirect interaction for rare earths in metals cannot adequately explain the experimental results. A mechanism with positive f–d exchange and direct d–d interactions is proposed and is shown to give satisfactory agreement with experiment. (auth)

57963 APPARENT EXTINCTION OF THE (111) NECK EFFECT IN THE ANGULAR CORRELATION OF POSITRON ANNIHILATION IN A DILUTE Cu–Mn SINGLE CRYSTAL BY QUENCHING. Tanigawa, S.; Nanao, S.; Kuribayashi, K.; Doyama, M. (Tokyo Univ.). J. Phys., F (London); 2: No. 3, L65-8(May 1972).

The effect of quenching on positron annihilation in single crystals of pure copper and Cu–0.5 at.% Mn was studied. From the results, the nature of electrons at the vacancy sites and the vacancy–impurity binding were discussed. (auth)

57964 PHOTOELECTRIC WORK FUNCTION OF CERTAIN HIGH-TEMPERATURE CATHODE MATERIALS. Kul'varskaya, B. S. (Inst. of Radioengineering and Electronics, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 16: No. 7, 1165-7(Jan 1972).

Translated from Zh. Tekh. Fiz.; 41: No. 7, 1481-4(Jul 1971).

The photoelectric work function of certain high-temperature materials used or recommended for use as thermionic cathodes, namely, ZrB_2, LaB_6, and $ZrB_2 \cdot 10\% LaB_6$, etc., were investigated. The spectral characteristics were measured and the photoelectric work functions were determined. Data are given on the thermionic work function for these materials. The following values of the work functions for a solid solution of $ZrB_2 \cdot 10\%$ LaB_6 were obtained: $\varphi_{ph} = 2.45 \pm 0.05$ eV and $\varphi_{th} = 2.47$ eV. From the fact that these two work functions are equal, and from data given in previous papers, a film mechanism is suggested for emission in the above materials: in activation, a thin film (approximately monatomic) of the metallic component La, Zr, or others is formed on the emitter surface. (auth)

57965 EFFECT OF OXIDE DEFECT STRUCTURE ON THE ELECTRICAL PROPERTIES OF ZrO_2. Kumar, Arun; Rajdev, Dilip; Douglass, D. L. (Univ. of California, Los Angeles). J. Amer. Ceram. Soc.; 55: No. 9, 439-45(Sep 1972).

The defect structure of monoclinic ZrO_2 was studied by measuring the transfer numbers and electrical conductivity as functions of O_2 pressure and temperature. The data suggest a defect structure of doubly ionized oxygen vacancies at low pressures, i.e., $<10^{-19}$ atm, and singly ionized oxygen interstitials at pressures $>10^{-9}$ atm. Zirconia is primarily an ionic conductor below ~700°C and an electronic conductor at 700 to 1000°C for $10^{-22} \le P_{O_2} \le 1$ atm. (auth)

57966 ELECTRONS AND SPIN WAVES IN HEAVY RARE EARTH METALS. Mackintosh, A. R. (Univ. of Copenhagen). CRC Crit. Rev. Solid State Sci.; 3: No. 2, 165-87(Jul 1972).

Emphasis is on the interrelation between the electronic structure of the heavy rare earths and their magnetic properties. The results of energy-band calculations are discussed, with emphasis on the manner in which the special characteristics of the atomic s–p, d, and f electrons are reflected in the electronic and magnetic properties of the metals. 16 figures, 40 references. (auth)

57967 ELECTRON LOCALIZATION IN V_nO_{2n+1} OXIDES ($n = 3, 4$). Casalot, A. (CNRS, Talence, France). Mater. Res. Bull.; 7: No. 9, 903-12(Sep 1972). (In French).

The application of Goodenough's method to the V_3O_7 and V_4O_9 oxides allows to localize the d electrons. In V_3O_7, where they are in d_{ZX} orbitals of V_1 and V_2 sites, V^{3+} ions announced by previous authors cannot exist. In V_4O_9 the presence of V^{4+} ions in three independent vanadium sites (the d electrons occupying a d_{YZ} orbital of V_1 and a d_{XY} orbital of V_3 and V_4) is not consistent with the chemical formula. It is proposed that the real formula is close to $V_4O_8(OH)$. The conduction properties of both phases are evaluated on the basis of their structures. (auth)

57968 CRYSTAL GROWTH, 1971. Proceedings of the Third International Conference, Marseille, France, July 5–9, 1971. Laudise, R. A.; Mullin, J. B.; Mutaftschiev, B. (eds.). J. Cryst. Growth; 13-14: 1-876(May 1972). (In several languages). (CONF-710729).

One-hundred and fifty-nine papers are included; separate abstracts were prepared for 14. The remaining 141 papers contain information on: nucleation, surface diffusion, simulation of nucleation and growth; adsorption and heterogeneous nucleation from the vapor phase, crystal morphology, growth forms, epitaxy; crystal-melt interface, growth of ice; characterization assessment of crystal perfection; vapor growth; electrocrystallization; solution growth; industrial bulk crystallization; hydrothermal growth; flux growth; melt growth-basic studies and semiconductors; melt growth-mainly oxides; eutectics, dendrites, inclusions; segregation and defects; and solid state transformations. Separate quoted authors, author, subject, and compound indexes are included. (P.C.H.)

For abstracts of individual papers see: 56621, 56622, 56670, 56704–56706, and 57969–57976.

57969 PHASE EQUILIBRIA PERTINENT TO THE GROWTH OF CUBIC BORON NITRIDE. DeVries, R. C.; Fleischer, J. F. (General Electric Co., Schenectady, N. Y.). J. Cryst. Growth; 13-14: 88-96(May 1972).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

The practical synthesis of cubic boron nitride (cubic BN) requires the simultaneous application of high temperatures and pressures. Since the discovery of cubic BN more detailed understanding of the chemistry of the process has been acquired from equilibria or "approach-to-equilibria" studies in the Li–B–N system. Some of these results are described and their application to the growth of borazon is considered. The principal compound that coexists with cubic BN at high pressures and temperatures is a high-pressure modification of Li_3BN_2 (called $Li_3BN_2(W)$). It was found that cubic BN does not form when this compound melts or decomposes. When BN is added to Li_3BN_2 in excess of the composition 53 mole% BN, 47 mole% Li_3N, then cubic BN precipitates from solution. At 55 kb, the system Li_3BN_2–BN has a eutectic at 6% BN and 1610°C and the upper limit of the cubic BN plus liquid region is at 1750°C. The solubility curve is a very steep function of temperature and consequently the system is not too favourable for crystal growth by slow cooling. These new results can be compared with previous results by plotting a series of P–T curves defining the stability region for cubic BN under different conditions. Good agreement was found between the solidus determined in the Li_3BN_2–BN study and the lower limit of the catalyst growth area. In effect, this lower limit is directly related to the initial formation of liquid in the Li_3BN_2–BN portion of the system. The lower temperature limit of growth of cubic BN reported from Li–BN compositions was below that of the present study and the catalyst growth area previously defined. This result would have some fundamental basis in fact if a lower temperature reaction involving cubic BN occurred in the ternary system Li–B–N. (auth)

57970 GROWTH OF CADMIUM WHISKERS IN VARIOUS ATMOSPHERES. Kitterman, J. H.; Winder, D. R. (Colorado State Univ., Fort Collins). J. Cryst. Growth; 13-14: 198-201 (May 1972).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

The growth of cadmium whiskers from the vapor is described. Growth rates were measured at a supersaturation of approximately 0.1 in atmospheres of argon and of an oxygen–argon mixture. The growth rates are dependent on the radius of the whisker, the chemical nature of the atmosphere, and the pressure. In argon, growth rates in excess of the classical linear law for tip impingement support the model of surface diffusion inhibited by the presence of the inert gas. This inhibited surface diffusion is the rate-controlling process. The addition of the active element oxygen increases the number of whiskers and dendritic growth while decreasing the growth rates of whiskers. This decrease is proportional to the partial pressure of oxygen but the effect seems to be less than that suggested in the previous literature. At the lower supersaturations, growth habits other than whiskers become dominant, with small platelets comprising the primary habit at the lowest supersaturation. The effects of a different inert gas were investigated by the substitution of helium for argon. (auth)

57971 EPITAXIAL GROWTH AND PROPERTIES OF SEMICONDUCTING ScN. Dismukes, J. P.; Yim, W. M.; Ban, V. S. (RCA Labs., Princeton, N. J.). J. Cryst. Growth; 13-14: 365-70(May 1972).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

The epitaxial growth of ScN was investigated in the temperature range 750 to 1150°C, using the reaction of ammonia with the volatile scandium halides produced by the reaction of HCl, HBr, or HI with Sc metal. The optimum temperature range for epitaxial growth of ScN on $\alpha-Al_2O_3$ was found to be 850 to 930°C. The linear thermal expansion coefficient of ScN was measured to be 8.1×10^{-6}/°C, a relatively good match to $\alpha-Al_2O_3$. Mass spectrometric studies suggest that the vapor species formed by the reaction of HCl with Sc metal is $ScCl_2$, and that this reacts further with NH_3, which is only 5 to 10% decomposed at 950°C, to form ScN. As-grown ScN is n-type with electron concentrations in the range 10^{20} to 10^{21} cm^{-3}, and halogen or hydrogen appears to be the principal donor. Doping with C and Si during growth did not give p-type material, nor did post-growth annealing in Mg and Zn vapor. The Hall mobility of ScN was 150 cm^2 V^{-1} sec^{-1} at 300°K for an electron concentration of 1×10^{20} cm^{-3}, and exhibited a $T^{-1.85}$ dependence between 300 and 77°K. The optical energy gap of ScN was 2.1 eV at 300°K. (auth)

57972 HYDROTHERMAL GROWTH OF SINGLE CRYSTALS OF HEAVY RARE EARTH HYDROXIDES. Mroczkowski, S.; Eckert, J. (Yale Univ., New Haven). J. Cryst. Growth; 13-14: 549-51(May 1972).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

The growth techniques for the lighter rare earth hydroxides proved unsuccessful for the heavier elements, Er – Lu. Solubility studies on $Er(OH)_3$ yielded data that could be applied to the modification of the earlier methods. The use of a large, specially cooled autoclave and the consequent large thermal gradients over the length of the growth region proved essential in the growth of macroscopic single crystals. Experimental details of the procedure are described. (auth)

57973 CRYSTAL GROWTH FROM THE FLUX SYSTEMS $PbO–V_2O_5$ AND $Bi_2O_3–V_2O_5$. Garton, G.; Smith, S. H.; Wanklyn, Barbara M. (Oxford Univ.). J. Cryst. Growth; 13-14: 588-92(May 1972).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

Fluxes of composition $2PbO \cdot V_2O_5$ and $4Bi_2O_3 \cdot V_2O_5$ were found to be particularly suitable to crystal growth. Starting compositions and conditions for growth are given for Al_2O_3, Cr_2O_3, Fe_2O_3, β-Ga_2O_3, ThO_2, TiO_2, $GaFeO_3$, $NiFe_2O_4$, $NiTiO_3$, Fe_2TiO_5, $TbNbO_4$, $ThPbV_2O_8$, and RVO_4 (R = rare earth ion). (auth)

57974 CRYSTAL GROWTH OF TRANSITION-METAL INTERSTITIAL COMPOUNDS BY A FLOATING-ZONE TECHNIQUE. Billingham, J.; Bell, P. S.; Lewis, M. H. (Univ. of Warwick, Coventry, Eng.). J. Cryst. Growth; 13-14: 693-7(May 1972).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

A floating-zone technique for the preparation of large high-purity crystals of vanadium carbide, oxide, and nitride with controlled stoichiometry is described. An essential feature of the process is the provision of a facility that enables growth under positive ambient gas pressures (up to 20 atm) to be carried out. Inert gas atmospheres are used to reduce vanadium vaporization losses in vanadium carbide and oxide and so enable closer compositional control to be achieved, while the nitrides are grown under similar pressures of nitrogen and helium to reduce nitrogen losses. Zone leveling enabled large single crystals of vanadium monocarbide (VC) with differing and closely controllable compositions to be produced. Vanadium monoxide crystals were grown over the whole cubic stoichiometry range, but in the vanadium – nitrogen system, single-phase cubic vanadium mononitride (VN) could not be produced and the microstructure of the alloy of highest nitrogen content consisted of a eutectic of the cubic VN and the hexagonal divanadium nitride (V_2N) phases. Finally, in addition to the usual chemical and optical microstructural examination, electron microscopy and electron diffraction were used to characterize the type and extent of the defect structures which are present in all three alloy systems studied. (auth)

57975 STUDY OF CONDITIONS FOR GROWTH OF BERYLLIUM MONOCRYSTALS. Deloche, J.; Malmejac, Y.; Schaub, B. (French Atomic Energy Commission, Grenoble). J. Cryst. Growth; 13-14: 814-17(May 1972). (In French).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

The Czochralski technique was used to prepare single crystals of beryllium. Various pulling parameters were studied in terms of the perfection of the produced single crystals: these results are related to the specific physical properties of the beryllium melt, chiefly its viscosity, its surface tension, its density, and its thermal diffusivity. The axial and radial distribution of various impurities (aluminium, copper, manganese) were measured by a radioactivation-analysis technique. They are related to the growth parameters. The crystalline quality of such crystals has been measured by neutron diffraction (rocking curves), and x-ray topography (Berg – Barrett and Lang methods). Disorientations of about 10 minutes were observed. (auth)

57976 ORIENTED GROWTH OF SUBOXIDES OF NIOBIUM IN A NIOBIUM MATRIX. Monfort, Y.; Maisseu, A.; Allais, G.; Deschanvres, A. (Faculte des Sciences, Caen, France). J. Cryst. Growth; 13-14: 829-33(May 1972). (In French).

From third international conference on crystal growth; Marseille, France (5 Jul 1971). See CONF-710729.

Tetragonal niobium suboxides NbO_x (Nb_8O) and NbO_z (Nb_3O) have been grown by solid-state oxidation of metallic niobium at 360 and 390°C, respectively. Electron-microscopy and diffraction studies were used to identify the lattice correspondence between the suboxides and the niobium solid solution matrix. The twinned structure of NbO_x allowed the interface energy of the twin planes, in the range of 22 to 28 erg/cm^2, to be determined. (auth)

57977 DOPPLER BROADENING OF ANNIHILATION RADIATION. Georgieva, M. K.; Tumbev, G. Kh. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 3, 297-300 (1972). (In Russian).

Data on the Doppler broadening of annihilation radiation of 29 elements were obtained using a Ge(Li) detector. This was interpreted as resulting from the considerable momentum of an electron – positron pair and a change in the energy distribution of annihilation γ quanta. The halfwidth Γ (in keV) was obtained by the method of least squares, and when Γ of the 29 elements was plotted as a function of the free-electron Fermi energy (E_F) a parabolic curve was obtained (concave upward) with Te, Ge, and Al at the minimum, best represented by $\Gamma = (0.0081 \pm 0.0005) E_F^2 - (0.19 \pm 0.01)E_F + (3.46 \pm 0.06)$. A treatment of Γ as a function of atomic number strongly suggested a periodicity with the number 18. (K.S.W.)

57978 MAGNETIC SUSCEPTIBILITY AND ORDERING OF SOLID SOLUTIONS OF ALUMINUM IN VANADIUM. Sidorenko, F. A.; Rabinovich, B. S.; Gel'd, P. V.; Radovskii, I. Z.; Korkin, I. V. Izv. Akad. Nauk SSSR, Metal.; No. 2, 119-22(1972). (In Russian).

An x-ray metallographic investigation showed that the limiting solubility of aluminum in vanadium at 1,150°C was 48% Al, whereas crude alloys were single-phase in the range 0 to 50% Al. The single-crystal compound $V_{52}Al_{48}$ possessed ordering of the CsCl type. Solid solutions of Al in V were weakly paramagnetic between 79 and 660°K. (K.S.W.)

57979 CALCULATION OF OPTICAL CONSTANTS AT ELEVATED TEMPERATURES USING THE INTEGRAL KRAMERS–KRONIG RELATIONS. Sayapina, V. I.; Svet, D. Ya.; Popova, O. R. Izv. Akad. Nauk SSSR, Metal.; No. 2, 210-12(1972). (In Russian).

The possibility of determining the optical constants n and k at elevated temperatures by the Kramers – Kronig method was investigated. Optical constants and absolute reflection coefficients obtained for W, Mo, Ta, and Cu are in agreement with experimental values for n and k taken from the literature. (K.S.W.)

57980 RECTIFICATION BY ANODIC OXIDE FILMS ON ZIRCONIUM. Ramasubramanian, N.; Trottier, T. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Electrochem. Soc.; 119: No. 10, 1375-80(Oct 1972).

The electrical conduction characteristics of anodic oxide films on zirconium were studied using evaporated metal and aqueous electrolyte contacts. All the films tested showed electrolytic rectification. In the dry systems rectification was not observed, but asymmetry in conduction was pronounced in the case of films grown in the nitric acid solution. Capacitance measurements under an applied dc bias provided no positive evidence for the presence of a p – n junction either in the bulk oxide or at the oxide – electrolyte boundary. The conduction characteristics were influenced by the anodizing electrolyte used: (i) the relatively flaw-free films grown in KOH gave nonohmic but nearly symmetrical I – V curves; (ii) a porous and hydrated oxide film, essentially monoclinic zirconia, grown in HNO_3 resulted in asymmetric conduction; and (iii) phosphate ion incorporation in oxides grown in a solution containing phosphoric acid led to space-charge-limited current-flow characteristics. (auth)

Moessbauer Effects and NMR

Refer also to abstract 56233.

57981 PERTURBED-ANGULAR-CORRELATION STUDIES OF THE QUADRUPOLE INTERACTIONS OF ^{111}Cd IN DIFFERENT METALLIC ENVIRONMENTS AND THE ELECTRIC QUADRUPOLE MOMENT OF THE 247-keV STATE. Bodenstedt, E.; Ortabasi, U.; Ellis, W. H. (Univ. of Florida, Gainesville). Phys. Rev., B; 6: No. 8, 2909-22(15 Oct 1972).

The quadrupole interactions of the 247-keV state of ^{111}Cd populated in the decay of ^{111}In were studied by time-dependent perturbed-angular-correlation measurements in environments of metallic indium and indium–cadmium alloys. Periodic undamped-spin-rotation curves were observed which prove that, in both cases, the axial-asymmetry parameter of the electric field gradient is close to zero and the spread of the interaction frequencies is negligibly small. The temperature dependence of the interaction frequencies in metallic indium is quite strong but deviates only slightly from that observed by Hewitt and Taylor for the stable indium isotopes in the same environment using the nuclear-quadrupole-resonance technique. The conclusion was made that the localized-moment contribution of the conduction electrons to the electric field gradient must be small in this case, and by using the results of Hewitt and Taylor for a calibration of the effective electric field gradient, the electric quadrupole moment of the 247-keV state of ^{111}Cd $Q_{5/2} = +0.44 \pm 0.07 \times 10^{-24}$ cm^2 was derived. The quadrupole interactions in the indium–cadmium alloy (0.94 at.% indium) were found to be an order of magnitude larger than in indium. This was expected because of the anomalously large c/a crystal-axes ratio of the hexagonal-close-packed (hcp) lattice of cadmium. The observed temperature dependence gives interesting information about the role of the conduction electrons as well as about the phase diagram of the cadmium–indium system. (auth)

57982 RELATIONS BETWEEN hfs COUPLING AND MOESSBAUER SPECTRA PARAMETERS OF ^{57}Fe IN POWDERED ABSORBERS. Dabrowski, L; Piekoszewski, J.; Suwalski, J. (Inst. of Nuclear Research, Swierk, Poland). Nucl. Instrum. Methods; 103: No. 3, 545-8(1972).

The relations between the energy levels of ^{57}Fe nuclei and the magnetic and electric hyperfine fields are analyzed. The polar angles specifying the orientation of H_{eff} with respect to the principal axes of EFG tensor and asymmetry parameter are expressed in closed form by the energy levels and the quantity $e^2Qq/[4I(2I-1)]$. The expressions for the ranges of the allowed values of EFG parameters for a given set of energy levels are derived and discussed. (auth)

57983 CRYSTALLOGRAPHIC TEXTURE AND DIFFERENTIAL PERTURBED ANGULAR CORRELATIONS. Kaufmann, E. N. (Bell Labs., Murray Hill, N. J.). Nucl. Instrum. Methods; 103: No. 3, 447-52(1972).

The effects of crystallographic texture in samples studied by the time-differential perturbed-angular-correlation technique (TDPAC) are described and a variation on the experimental method is suggested. The results of a representative calculation are compared with experiment for ^{181}Ta in rolled Zr. (auth)

57984 OBSERVATION OF THE DIFFRACTION OF 14-keV γ RAYS BY A GRATING. Cranshaw, T. E. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Lett.; 39A: No. 4, 296(22 May 1972).

The experiment of Isaak and Preikschat (Phys. Lett., 38A: 257 (1972)) on the amplitude modulation of γ rays is shown to be more satisfactorily explained in terms of the diffraction of radiation by a grating. (auth)

PHYSICS (THEORETICAL)

Refer also to abstracts 57167, 57431, 57434, 57453, 57468, 57470, and 57481.

57985 (NP–19450) PROGRESS REPORT NO. 18: SESSION 1971–72. (Oxford Univ. (England). Mathematical Inst.). 1972. 150p. Dep. NTIS (U. S. Sales Only).

Research on quantum theory, atomic and molecular structure, and problems in wave mechanics are summarized. A list of publications is included. (J.F.P.)

57986 (USC–113–P–19–22) NOTE ON AN ADDITION THEOREM FOR BERNOULLI NUMBERS AND THE ITERATIVE SOLUTION OF THE RICCATI EQUATION. Technical Report No. 72-30. Vasudevan, R. (University of Southern California, Los Angeles. Dept. of Electrical Engineering). Jun 1972. Contract AT(04-3)-113. 8p. Dep. NTIS.

An addition theorem for Bernoulli numbers is deduced from the successive iterative solutions of the Riccati equation. These iterative solutions arise when the Riccati equation is linearized in a novel fashion as indicated in Bellman et al., Matrix Riccati Equation of Transport Processes, USC Tech. Rep. No. 72-13. (auth)

57987 WAVE OPERATORS FOR THE SCHROEDINGER EQUATION WITH A FAST-OSCILLATING POTENTIAL. Matveev, V. B.; Skriganov, M. M. (Leningrad State Univ. Inst. of Mathematics, Leningrad). Dokl. Akad. Nauk SSSR; 202: No. 4, 755-7(1 Feb 1972). (In Russian).

The existence of full wave operators (2) for a broad class of "rapidly" oscillating potentials, which are also possibly unlimited for $|x| \rightarrow \infty$, is discussed. The approach used for the problem is that of constructing a finite operator T in such a way that the operator $Q = HT - TH_0$ locally appears nuclear. The existence of generalized wave operators may thus be demonstrated. (K.S.W.)

57988 FINITE-DIFFERENCE BOUNDARY-VALUE METHOD FOR SOLVING ONE-DIMENSIONAL EIGENVALUE EQUATIONS. Truhlar, Donald G. (Univ. of Minnesoata, Minneapolis). J. Comput. Phys.; 10: No. 1, 123-32(Aug 1972).

The finite difference boundary value method for obtaining eigenvalues and eigenfunctions of the one-dimensional Schroedinger equation is discussed. The method is noniterative and may be applied to one-dimensional problems on $(-\infty, \infty)$ or to the radial equation on $(0, \infty)$. A computer program which computes the eigenvalues and any desired matrix elements involving the eigenfunctions is available from Quantum Chemistry Program Exchange. (auth)

57989 DETERMINATION OF ACCURATE POTENTIAL STRENGTHS TO YIELD SPECIFIED EIGENVALUES OF THE RADIAL SCHRODINGER EQUATION. Dickinson, A. S. (Univ. of Stirling, Scotland). J. Comput. Phys.; 10: No. 1, 162-6 (Aug 1972).

Previous methods are modified to determine the critical strength or critical coupling constant of a potential for specified eigenvalues of the radial Schroedinger equation. This can be used to study the existence of a bound state of the helium molecule arising from the interactions of two ground-state helium atoms and the highest principle quantum number likely to be observed in radiation from a plasma. (J.F.P.)

57990 ANALYTIC METHODS IN MATHEMATICAL PHYSICS. Conference Held at Bloomington, Indiana, June 2–6, 1968. Gilbert, Robert P.; Newton, Roger G. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1970). 587p. (CONF-680678).

Seventeen invited papers are included in Part I, which cover general areas of fluid dynamics, elasticity, heat conduction, gravitational theory, quantum mechanics, quantum field theory, eigenvalue estimates in quantum mechanics and elasticity, and selected topics in complex analysis. In addition, twenty-nine short lectures are included in Part II. Abstracts are prepared for the fifteen papers within the scope of NSA. (L.B.S.)

For abstracts of individual papers see: 57421–57425, 57468–57473, and 57991–57994.

57991 SINGULARITIES OF ALGEBRAIC CURVES. Abhyankar, Shreeram Shankar (Purdue Univ., Lafayette, Ind.). pp 3-14 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

A brief exposition is given of some aspects of the theory of singularities of algebraic curves. Various approaches to classifying singularities of algebraic curves are described: geometrical, algebraic, arithmetical, and topological. (L.B.S.)

57992 GROUP REPRESENTATION ON HILBERT SPACES OF ANALYTIC FUNCTIONS. Bargmann, V. (Princeton Univ., N. J.). pp 27-63 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

Hilbert spaces on analytic functions are used for an analysis of representations of sympletic groups of various dimensions. The following topics are discussed: the Hilbert space and the operators; the symplectic groups; representations of the symplectic group, and representations of the de Sitter and the Lorentz groups. (L.B.S.)

57993 UNIVERSAL TEICHMUELLER SPACE. Bers, Lipman (Columbia Univ., New York). pp 65-83 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

A description is given of the universal Teichmueller space. The representation of Riemann surfaces by Fuchian groups is reviewed in order to explain how spaces of Riemann surfaces appear as subspaces of the universal Teichmueller space. Some results on Kleinian groups are stated and a brief report is included on the boundary of Teichmueller space. (L.B.S.)

57994 SUPERSPACE. Wheeler, John Archibald (Princeton Univ., N. J.). pp 335-78 of Analytic Methods in Mathematical Physics. /Gilbert, Robert P. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1970).

From Conference on analytic methods in mathematical physics; Bloomington, IN. (2 Jun 1968). See CONF-680678.

A brief history is given from Riemann and Clifford to Einstein's geometrodynamics. A detailed comparison is made of Maxwell's electrodynamics and Einstein geometrodynamics. The classical gravitational field of a proton is compared with quantum fluctuations in field. The quantum-geometrical interpretation of particles and forces is presented. It is then argued that superspace is the dynamic arena of geometrodynamics and that superspace is the totality of all 3-geometries. (L.B.S.)

57995 DISTRIBUTION FUNCTIONS IN VIRIAL AND HYPERVIRIAL THEORY. Farmer, C. M. (Royal Holloway Coll., London). J. Phys., A (London); 5: No. 8, 1138-51(Aug 1972).

The forms of the virial and hypervirial theorems are derived when a distribution function, that is, the Laplace transform of a distribution, is taken to define a quantum-mechanical system. The validity of the resulting equations imposes necessary (and sufficient) conditions on the distribution and hence the distribution function. Distribution theory is used to establish the existence of an exponential function satisfying the virial theorem for the Yukama potential for a restricted range of the defining parameters. For hypervirial relations, the method would seem of little practical importance. (auth)

57996 VARIATIONAL TRIAL FUNCTIONS IN QUANTUM THEORY. I. BOUND STATES. John, T. L.; Williams, K. L. (University Coll. of South Wales, Cardiff). J. Phys., A (London); 5: No. 8, 1152-64(Aug 1972).

A method is given, calculating variational trial functions in quantum theory. Applications are made to the discrete spectra of some simple one and two particle systems. (auth)

57997 ONE DIMENSIONAL HARMONIC OSCILLATOR IN A QUANTUM MECHANICS HAVING A NONNEGATIVE DISTRIBUTION FUNCTION IN PHASE SPACE. Kuryshkin, V. V. (Institut de France, Paris). Compt. Rend., Ser. B; 274: No. 21, 1163-5 (24 May 1972). (In French).

The study of a one-dimensional harmonic oscillator in an arbitrary subquantum situation $\varphi_k(q,t)$ leads to the establishment of a time dependence for the subquantum complements and to quantitative changes in the results. (France)

57998 DYNAMICAL GROUPS AND GENERALIZED SYMMETRIES IN QUANTUM THEORY. (WITH APPLICATIONS IN ATOMIC AND PARTICLE PHYSICS). Barut, A. O. Portland, Oreg.; International Scholarly Book Services, Inc. (1972). 105p. $6.50.

The treatment covers kinematical principles of quantum theory, determination of concrete linear spaces, review of mathematical results on compact and noncompact Lie groups and Lie algebras, explicit construction of representations of O(3) and O(2,1) dynamical groups, the interaction of composite systems with external fields and passage to relativistic theory, and the infinite-component wave equation. (J.F.P.)

57999 QUANTUM-MECHANICAL DESCRIPTION OF MANY-PARTICLE REACTIONS. Kanellopoulos, Th.; Wildermuth, K. (Univ., Tuebingen, Ger.). Particles Nucl.; 4: No. 1, 1-25(Jul 1972).

An ansatz for reaction theory in the quantum mechanical description of many-body reactions is found which makes it possible to overcome the essential difficulties in the treatment of these reactions and to describe the general properties of many-particle systems. The difficulties of the customary reaction theories for the scattering of two hydrogen atoms, the reformulation of the time-dependent Schroedinger equation, neutron scattering on alpha particles, triton—deuteron elastic scattering, extension to general reaction equations, derivation of some general properties, and further methods for the numerical treatment of bound states and reactions are covered. (J.F.P.)

58000 VARIATIONAL TRIAL FUNCTIONS IN QUANTUM THEORY. II. CONTINUOUS SPECTRUM. John, T. L.; Williams, K. L. (University Coll. of South Wales, Cardiff). J. Phys., A (London); 5: No. 8, 1165-75(Aug 1972).

A method given previously for the calculation of variational trial functions is applied to the continuous spectra of some simple one- and two-particle systems. (auth)

58001 QUANTUM THEORY OF MEASUREMENT AND MACROSCOPIC OBSERVABLES. Hepp, Klaus (Eidgenoessische Technische Hochschule, Zurich). Helv. Phys. Acta; 45: No. 1, 237-45(1972).

The generation of probabilities from probability amplitudes in a quantum mechanical measurement process is discussed in the framework of infinite quantum systems. In several explicitly soluble models, the measurement leads to macroscopically different "pointer positions" and to a rigorous "reduction of the wave packet" with respect to all local observables. (auth)

58002 TEMPLE LOWER BOUND FOR EIGENVALUES. Delves, L. M. (Univ. of Liverpool). J. Phys., A (London); 5: No. 8, 1123-30(Aug 1972).

The relation between the Temple, Weinstein, and Stevenson bounds for an arbitrary eigenvalue of a Hamiltonian H is examined. It is shown that, in a sense which is defined, the Temple and Stevenson bounds are numerically equivalent, while the Weinstein bound is inferior to either. The Temple bound is reformulated and it is shown that the usual restriction on its validity may be relaxed; the relaxation leads to rather more convenient calculations in the presence of excited states, but not to improved lower bounds. A numerical example demonstrating the extension is given. (auth)

58003 INVARIANTS OF THE EQUATIONS OF WAVE MECHANICS. I. Anderson, Robert L.; Kumei, Sukeyuki; Wulfman, Carl E. (Univ. of the Pacific, Stockton, Calif.). Rev. Mex. Fis.; 21: No. 1, 1-33(1972).

Lie's method of finding the invariants of differential equations is generalized and the generalization is applied to the time-dependent and time-independent Schroedinger equations. Invariants containing both finite- and infinite-order derivatives with respect to the coordinates are obtained. A physical classification of the invariants, and of their groups is outlined. The method is illustrated by applying it to several physically interesting differential equations involving one space coordinate. (auth)

58004 INVARIANTS OF THE EQUATIONS OF WAVE MECHANICS. II. ONE-PARTICLE SCHROEDINGER EQUATIONS. Anderson, Robert L.; Kumei, Sukeyuki; Wulfman, Carl E. (Univ. of the Pacific, Stockton, Calif.). Rev. Mex. Fis.; 21: No. 1, 35-57(1972).

Employing the systematic methods of previous work, the invariants and dynamical groups of the time-dependent Schröedinger equation for the two-dimensional harmonic oscillator, and the two- and three-dimensional hydrogenlike atom are derived. (auth)

58005 IRREVERSIBILITY IN THE MANY-BODY PROBLEM. Sitges International School of Physics, May 1972. Biel, J.; Rae, J. (eds.). New York; Plenum Publishing Corporation (1972). 481p. $29.50.

The problems of irreversibility in statistical mechanics are treated including an introduction to irreversibility, ergodicity and related topics, irreversibility in many-body systems, infinite dynamical systems and time evolution, nonequilibrium statistical mechanics. Also covered are hydrodynamical concepts in statistical physics, fluctuations, hydrodynamics of magnetic crystals, symmetry breaking instability, and Brownian motion and the stochastic theory of quantum mechanics. (J.F.P.)

58006 BOUND EIGENSTATES OF THE EXPONENTIAL COSINE SCREENED COULOMB POTENTIAL. Lam, C. S.; Varshni, Y. P. (Univ. of Ottawa). Phys. Rev., A; 6: No. 4, 1391-9(Oct 1972).

A number of properties of the bound eigenstates of an electron in an exponential cosine screened Coulomb potential, $V(r) = -(e^2/kr)e^{-qr} \cos(qr)$, are studied. Perturbation and variation methods are used to calculate the eigenvalues. Detailed results are presented for the first four s states. For each state there is a critical value of the screening parameter δ_c above which no bound states with negative energy exist. The value of δ_c for the ground state is obtained from a two-parameter variational calculation. The total number of different energy levels is finite for any value of the screening parameter δ greater than zero, and is found to be approximately linearly dependent on $1/\delta_c$. The square of the number of bound s states is also shown to be linear with $1/\delta_c$. Positive-energy states are also discussed. (auth)

58007 SO(2,1) AND THE HULTHEN POTENTIAL. Dunlap, Brett I.; Armstrong, Lloyd Jr. (Johns Hopkins Univ., Baltimore). Phys. Rev., A; 6: No. 4, 1370-4(Oct 1972).

The s-state eigenfunctions of the Schroedinger equation for an electron in a Hulthén potential are shown to form a basis for an irreducible unitary representation of SO(2,1). The properties of this SO(2,1) are then applied to a study of the difference between the Hulthén potential and a screened Coulomb potential. Results compare well with those obtained by Lam and Varshni using a direct integration. (auth)

58008 EXCHANGE INDUCED CORRELATIONS. Baltensperger, W. (Eidgenoessische Technische Hochschule, Zurich). Helv. Phys. Acta; 45: No. 1, 203-14(1972).

An explicit variational many-body wave function, which contains correlations between fermions of opposite spin, is discussed. Energetically it profits from the off-diagonal exchange part of a repulsive interaction. In a simple model the state can only exist if the product of the exchange integral and the level density exceeds 3. The spectrum of the single particle excitations has a gap, which does not occur for certain double excitations. It is suggested that the theory applies to the 3d band of ferromagnetic transition elements, since it leads to a reduced observed band width and a majority spin polarization of photoelectrons. (auth)

58009 SPECTRAL THEORY OF SCHROEDINGER OPERATORS OF MANY-BODY SYSTEMS WITH PERMUTATION AND ROTATION SYMMETRIES. Balslev, Erik (State Univ. of New York, Buffalo). Ann. Phys. (N. Y.); 73: No. 1, 49-107(Sep 1972).

The spectra of many-body Schroedinger operators with permutation and rotation symmetry on subspaces of a given symmetry are investigated. For relatively compact two-body interactions the essential spectrum is a half line starting at the lowest two-body threshold with compatible symmetry. For dilatation analytic interactions the singular continuous spectrum is empty, and the eigenvalues accumulate at most at thresholds with compatible symmetries. For systems of atomic type there is an infinite sequence of discrete eigenvalues of each symmetry type. (auth)

REACTOR TECHNOLOGY

58010 OPTIMUM SHUTDOWN OF A HIGH-FLUX REACTOR. Zaritskaya, T. S.; Rudik, A. P. This paper was summarized in At. Energ. (USSR); 30: No. 4, 382(Apr 1971) as paper No. 475/5610. (In Russian).

Full copy of this paper is held by TIC.

The problem of finding the optimum reactor shutdown regime ensuring maximum energy release during the transient process is considered. The reactor power is chosen as the function to be varied, and L. S. Pontryagin's maximum principle is used to find the general form of the optimum path: (1) zero power until the Xe concentration reaches its maximum admissible value (MAV), (2) power varying so that the Xe concentration remains constant at its MAV, and (3) maximum power up to the time of planned shutdown. The gain in released energy during the optimum transient process is given. (D.L.C.)

58011 CALVERT CLIFFS DECISION. Grenon, Michel. Rev. Fr. Energ.; 23: No. 237, 147-55(Dec 1971). (In French).

It is not possible to build or operate a nuclear plant in the United States without first having obtained a permit. The already burdensome procedure for obtaining such a permit has been further complicated by the enactment of the 1969 antipollution laws. After outlining the relevant procedural steps and the substance of the antipollution laws, the decision taken on July 23, 1971, by the Federal Court of Appeals in the Calvert case is stated, and the principal arguments are given. The position of the USAEC is made clear from essential points cited from the speech of the chairman of the Commission (James Schlesinger). (France)

Power Reactor Development

Refer also to abstracts 55937 and 58337.

58012 (CONF-720627–, pp 4.1-34) CURRENT STATE OF THE ART IN NUCLEAR POWER. Carr, F. H. (Australian Atomic Energy Commission, Sydney).

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

Nuclear power plant development in the UK, USSR, USA, France, Sweden, Canada, and the German Federal Republic is briefly reviewed and an outline is given of progress in the development of the main reactor systems (PWR and BWR, gas cooled, graphite moderated reactors, heavy water moderated reactors, breeder reactors), with special consideration for reactor safety and economic factors. (Australia)

58013 (CONF-720627–, pp 5.20-6) SOME COMMENTS ON THE FUTURE OF THE FAST BREEDER REACTOR. Alder, K. F. (Australian Atomic Energy Commission, Sydney).

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

An evaluation is made of the part which FBR type reactors are expected to play in nuclear technology to the end of the century, with special reference to enrichment requirements. It is expected that there will be a reduction in the rate of rise in demand for uranium and for enrichment, but rising demands and stability can be expected for 40 to 50 years. (Australia)

58014 (JAPFNR–29) OUTLINE OF THE JAPAN EXPERIMENTAL FAST REACTOR "JOYO". (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Translated from report PNC-N–241-72-15. 28p. Dep. NTIS (U.S. Sales Only).

The development of the Joyo Reactor is described historically. The reactor, its functions, and its systems are described. The design parameters are given. (J.M.J.)

58015 (JAPFNR–50) PROGRESS AND PRESENT STATUS OF FBR DEVELOPMENT IN JAPAN. (Power Reactor and Nuclear Development Corp., Tokyo (Japan)). Translation of report PNC-N–141-72-1-21. 8p. Dep. NTIS (U. S. Sales Only).

The status of fast breeder reactor development in Japan is discussed briefly. The status of the Joyo and the Monju Reactor projects is treated. (J.M.J.)

58016 (JAPFNR–51) PRESENT STATUS OF LMFBR DEVELOPMENT PROGRAM AT PNC, JAPAN. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Translation of report PNC-N–141-72-1-22. 4p. Dep. NTIS (U. S. Sales Only).

The status of fast breeder reactor development in Japan is lightly touched upon. The Monju and Joyo Reactors are mentioned slightly. (J.M.J.)

58017 (JAPFNR–52) PRESENT STATUS OF "MONJU" (THE PROTOTYPE FAST REACTOR IN JAPAN). (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Translation of report PNC-N–141-72-1-23. 7p. Dep. NTIS (U. S. Sales Only).

The status of the Monju Reactor project is reviewed briefly. Some design parameters are included. (J.M.J.)

58018 (ORNL-NSIC–98) COMPILATION OF NUCLEAR STANDARDS, 8th EDITION, 1971. PART I. UNITED STATES ACTIVITIES. (Oak Ridge National Lab., Tenn.). Feb 1972. Contract W-7405-eng-26. 208p. Dep. NTIS.

All United States activities in nuclear standards preparation are presented in tables. The technical, industrial, and environmental organizations are listed alphabetically and their standards activities are given. Approved standards, unapproved drafts, and proposed activities are listed. Standards activities are indexed both by organization and by permuted title. (H.D.R.)

58019 PROBLEMS POSED BY THE INTEGRATION OF NUCLEAR POWER PLANTS INTO THE ELECTRICAL GRID SYSTEM OF THE FEDERAL REPUBLIC OF GERMANY. Huenlich, W. H. F. (United German Electrical Works, Frankfurt am Main). Energ. Nucl. (Paris); 14: No. 2, 139-48(1972). (In French).

The present situation concerning the production of electricity in the Federal Republic of Germany is presented. The maximum possible electrical power and the energy output of power stations using different sources of energy, the evolution of the relative importance of each of these sources in the total energy output of national enterprises between 1960 and 1970, and the structure of the interconnected grid system, are discussed. The future requirements are analyzed together with problems posed by the competition between the different energy sources, the choice of sites, the developments envisaged in the grid system, and its financial viability. (France)

58020 GERMAN NUCLEAR INDUSTRY. Sauerwald, K. J. (Power-Station Union AG, Erlanger, Ger.). Energ. Nucl. (Paris); 14: No. 2, 96-102(1972). (In French).

The development of the nuclear industry in the Federal Republic of Germany since 1955 is discussed. The interrelation between the state, research centers, and private enterprise is described, this interrelation leading to a form of mutual cooperation not found in other industrialized countries. The nuclear program pursued by the German industry, and the types of reactor favored, are described. Information concerning the construction of reactors in the Federal Republic of Germany is given. (France)

58021 FUTURE ASPECTS OF NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Throm, W. Elektrotech. Z., B; 23: No. 19, 454-7(1971). (In German).

A general review is given on power generation by nuclear reactors. A table is included which gives the nuclear power plants in the Federal Republic of Germany, either in operation, under construction, or planned (state end of June 1971). (INIS)

58022 NUCLEAR POWER DEVELOPMENTS. Warner, R. K. Aust. Mining; 64: No. 5, 16-18(May 1972).

Progress in development of reactors for electricity generation is reviewed and briefly compared with fossil fuel plants. The number of units and the generating capacity of each reactor type in all countries to June 1971 are summarised. Installed nuclear power capacity in the world is expected to reach 280,000 MW(e) by 1980 and 580,000 MW(e) by 1985. Annual U_3O_8 required would be 39,000 short tons by 1975 and 134,000 short tons by 1985. Australia's recoverable U_3O_8 resources in mid 1970 were 21,700 short tons U_3O_8 but 100,000 short tons is expected to be proven in the Northern Territory within 2 years at the current rate of exploration. (Australia)

58023 NUCLEAR POWER BEGINS TO SHOW ITS EDGE. Can. Chem. Process.; 56: No. 6, 50-4(Jun 1972).

Canada has three versions of the CANDU heavy-water-moderated natural-uranium power-reactor system: pressurized heavy water (PHW), with 1.5 of 2 GW already working at Pickering, and 3 GW planned at Bruce; boiling light water (BLW), with a 0.25 GW prototype at Gentilly; organic-cooled (OCR), still in the pilot stage at Pinawa. The third unit at Pickering reached full power in 18 days. Pickering cost $313/kW, and running costs will be less than $4.50/$10^3$ kW·h, against $4.90 for a coal station. Cost and design factors for current and advanced PHW and BLW, and OCR, are compared. The BLW design could be improved by using enriched fuel, or possibly by raising exit steam quality to 40%. The OCR, if developed, would have lower capital and fuel costs than PHW or BLW. Breeder OCRs are discussed. The Valubreeder would use U/Pu/Th fuel in a 1.5 GW OCR. Valubreeder design is based on under-moderated lattices with fuel bundles of large diameter containing some graphite. It would be competitive with the high-temperature gas-cooled reactor. (N.D.H.) (Canada)

58024 FRENCH FAST BREEDERS. Vendryes, G.; Carle, R. Combustion; 43: No. 12, 44-6(Jun 1972).

Operation of RAPSODIE and construction of the Phenix Demonstration Plant are discussed. (M.C.G.)

58025 INTERNATIONAL DEVELOPMENTS IN ALTERNATIVE COOLANT FAST BREEDER REACTORS. Gratton, C. P. (European Association for the Gas Breeder Reactor, Brussels). Combustion; 43: No. 12, 38-42(Jun 1972).

European and USA studies on gas-cooled fast reactors and technical features of the gas-cooled fast reactor are discussed. (M.C.G.)

58026 STATUS REPORT: U. S. LMFBR PROGRAM. Behnke, Wallace B.; Shaw, Milton; Watson, James E. (Commonwealth Edison Co., Chicago. Atomic Energy Commission, Washington, D. C. Tennessee Valley Authority, Chattanooga). Combustion; 43: No. 12, 22-4; 29-36(Jun 1972).

The energy situation, fuel availability, long-term outlook, need for the breeder, the LMFBR demonstration plant program, financial arrangements, technical features of the plant, environmental statement, second plant, LMFBR base technology effort, LMFBR fuels and materials program, physics, components and instrumentation, and EBR-II are discussed. (auth)

58027 WHO, WHAT, WHY, WHEN, AND WHERE OF FAST BREEDER REACTORS. Combustion; 43: No. 12, 19-21(Jun 1972).

58028 EXPERIENCE IN LICENSING OF NUCLEAR POWER PLANTS. Bliss, Henry E.; Stiede, Wayne L. (Commonwealth Edison Co., Chicago). Combustion; 43: No. 12, 14-18(Jun 1972).

The permit chronology of Commonwealth Edison's nuclear units is described and the aspects that contribute to the delay in obtaining the required permits are discussed. (M.C.G.)

58029 STATE OF THE NUCLEAR POWER INDUSTRY, 1972. Wylie, Robert D.; Meckel, Nelson T. (Southwest Research Inst., San Antonio, Tex.). Combustion; 43: No. 12, 10-13(Jun 1972).

The state-of-the-art of the nuclear power program, its achievements, its potentials, and its problems are described. (M.C.G.)

58030 FAST BREEDER REACTOR DEVELOPMENT IN THE USSR. Taylor, John J. Combustion; 44: No. 1, 6-11(Jul 1972).

A brief review is given of the status of the Soviet fast-breeder program, as gathered on the 1971 visit of the Glenn Seaborg delegation. The Soviet program is being concentrated on the sodium-cooled oxide-fueled version of the LMFBR. The following reactors are described: BR-5, BR-60, BN-350, and BN-600. Comparisons are made between the Soviet and U. S. programs. (D.L.C.)

Physics and Core Engineering

58031 (INIS-mf–199) THERMOHYDRAULIC ACTIVITIES WITH RESPECT TO THE FAST BREEDER REACTOR DEVELOPMENT IN THE NUCLEAR RESEARCH CENTER, KARLSRUHE. Hoffmann, H.; Meerwald, E.; Schultheiss, G. F. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (West Germany)). 1971. 9p. (CONF-710317–5). INIS.

From sixteenth nuclear congress; Rome, Italy (25 Mar 1971).

One of the main activities of the Karlsruhe nuclear research center is the work concerning fast breeder reactor development. Within this region, thermohydraulic investigations are carried out on the three coolants under discussion, namely sodium, helium, and superheated steam. The goal of these investigations is the preparation of data for an optimal design of the reactor components, the most important being the fuel elements and the reactor core. As far as thermohydraulic reactor design is concerned, the investigations are concentrated on the preparation of computer programs for calculation of the three-dimensional temperature fields of the core, the fuel bundle, and the fuel pin including statistical hot-spot analysis. The theoretical considerations are confirmed experimentally in test rigs working with the coolants sodium, water, air, helium, and superheated steam. The experiments are concerned with investigations of the pressure drop, heat transfer, and coolant cross-mixing in bundle geometries with different spacer designs. In the field of reactor safety, the theoretical and experimental investigations deal mainly with the problems and early detection of coolant flow-disturbance, integral and local boiling phenomena in rod clusters, and the fuel–sodium interactions. The main topics of this work are investigations of nucleation, growth and condensation of sodium vapor bubbles, dry-out problems and the effect on system integrity. (GF)

58032 (JAERI-M–4503) TREATMENT OF THE FISSION PRODUCTS CROSS SECTIONS FOR PREDICTING THE BURN-UP CHARACTERISTICS OF A FAST REACTOR. Hasegawa, Akira; Katsuragi, Satoru; Tone, Tatsuzo (Japan Atomic Energy Research Inst., Tokyo). Jul 1971. 99p. (In Japanese). NTIS (U. S. Sales Only).

The time dependent (n,γ) reaction group cross sections of fission products, important for the long-period burnup analysis, has been studied for a few fissionable nuclides by considering the variation in weighting number densities with burnup. The capture data in UKNDL File and yield data recommended by Meek and Rider were used. For the cross sections not available in UKNDL File, these were obtained from the statistics and odd-even characteristics in UKNDL File. The time dependence of F.P. group cross sections due to the variation of number densities during the burnup is not important, except in the reactors with soft core spectrum; the change is less than 5%. The yield data treated are for the following species: Pu-239 and U-235 (both thermal and fast neutron fission energy), U-238 (fast fission energy), and Pu-241 (thermal fission energy). The group structure used is the same as in the 70-group JAERI-FAST set. (auth)

58033 (JAPFNR–47) SURVEY STUDY OF JOYO MARK-II CORE. (Sumitomo Electric Industries, Ltd., Osaka (Japan). Mitsubishi Atomic Power Industries, Inc., Omiya (Japan)). Translation of report PNC-N–141-72-1-18. 3p. Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan).

The preliminary design of the Joyo Reactor core is described briefly. The number, enrichment, and dimensions of the fuel elements are discussed. (J.M.J.)

58034 (JAPFNR–56) EXPERIMENTS FOR THE JOYO CORE COMPONENTS THERMAL BOWING ANALYSIS. [PART] II. Kumaoka, Yoshio; Kawada, Toshiyuki (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa Prefecture (Japan)). Translation of a Japanese report. 92p. (PNC-SJ–201-71-26). Dep. NTIS (U. S. Sales Only).

The thermal bowing phenomena of the Joyo core components were analyzed. Thermal bowing of the core components was simulated. To find out the main components which affected the phenomena, the real displacements of the core components and the restrained loads exerted on the spacer pads were measured. The applicability of the computer codes to the results gained from the experiments was verified. (7 references) (auth)

58035 (RT/FIMA–(72)2) STATUS REPORT ON THE STATIC AND BURNUP 3-D CODE FOR THE ITALIAN FAST REACTOR DESIGN CALCULATIONS. Mango, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 5 May 1972. 155p. Dep. NTIS (U. S. Sales Only).

A 3-dimensional static and burnup code is required to perform calculations of the fuel element and of the PEC prototype reactor of CNEN. The CITATION code, edited at Oak Ridge National Laboratory, has been selected as basic code; modifications required by the features of PEC reactor will be introduced in the CITATION code. In 1971 the CITATION code was improved to include a model to collapse the available many groups cross section libraries in few groups libraries. The modified code is described in the present report. Information is given on the use of the code. (auth)

58036 THERMAL RESISTANCE BETWEEN HEXAGONALLY ARRAYED CHANNELS. Inoue, Kataro; Kawai, Toshio (Hitachi Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 9: No. 2, 116-18(Feb 1972).

A typical gas cooled reactor core has fuel rods and coolant channels arrayed hexagonally in graphite blocks. The maximum temperature of the fuel pin is one of the main preoccupations in design calculation, since this factor restricts the power density of the core. A considerable temperature difference is present in the graphite. A convenient method for approximate estimation of the temperature difference in the graphite is described. (auth)

58037 CANDU PROGRAM SPARKS INNOVATIONS. Can. Chem. Process.; 56: No. 2, 25-31(Feb 1972).

To further its schedule to increase Canada's supply of nuclear energy from 1 million kW at present to nearly 6 million by 1975, Atomic Energy of Canada Ltd. (AECL) is spending $6 to 7 million per year on cooperative development projects with Canadian industry, and pays another \$6 million for specialized services. The following firms and projects are some of a number mentioned: Westinghouse Canada—heat transfer and fluid dynamic testing; Keene Corp. of Canada—purification of helium, air dryers, and distillation of transformer oil; Babcock and Wilcox—reliable heat exchangers; Champlain Power Projects—pump seals. AECL's own mechanical-engineering development program is outlined. Emphasis is laid on the developments necessary to minimize loss or dilution of heavy water from the primary coolant circuit of heavy-water-cooled reactors. The design of pumps and valves for the hot heavy water is discussed. Trends or developments in the design of valves include bellows-sealed stems for small valves, welded body bonnet joints, fluoroplastic seals, and oxidized Zircaloy-2 valve stems. Development work previously done in collaboration with Erco Chemical on an improved electrolytic cell for upgrading diluted deuterium oxide is being continued by AECL alone. (Canada)

58038 CRITICAL EXPERIMENTS IN A BWR LATTICE USING NAIG CRITICAL ASSEMBLY. Kurosawa, Fumio; Sekiguchi, Yoshiyuki; Yokoyama, Tsutomu. Toshiba Rev., Int. Ed.; No. 69, 14-19(May 1972).

Various experiments were made on a BWR core with the NAIG critical assembly and at the same time an analysis was carried out using the BWR nuclear characteristic calculation method. This article describes the NCA equipment, the tested core configurations, the experimental items, the experimental methods, and the analytical results. Lastly, some of the results are introduced with conclusions drawn from the experiments. (auth)

58039 METHOD OF CORE THERMAL CALCULATION FOR MULTICHANNEL ON SODIUM-COOLED FBR. Miyamoto, Yoshiaki (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 9: No. 3, 186-8(Mar 1972).

The coolant temperature in the vicinity of a wrapper tube must be estimated carefully because of the mixing effect. The lumped (subchannel) model and the MULMIX code were used to calculate the coolant temperature for the 50-MW(t) JOYO reactor in the core radial direction. The coolant temperature distribution in the blanket zone is also given. (D.L.C.)

58040 POSSIBILITY OF APPLYING THE ENERGY MODAL METHOD TO ANALYSIS OF FAST CRITICAL EXPERIMENTS. Kiguchi, Takashi (Hitachi Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 9: No. 5, 268-76(May 1972).

The possibility of analyzing the integral data obtained by fast critical experiments in the two-mode framework was investigated by numerical experiments. The nuclear model is a 26-group zero-dimensional one, maintaining criticality by energy-independent geometrical buckling. Two energy modes used were chosen by observing the distribution of fundamental spectra of various assemblies on the reaction-rate space. By synthesizing these two modes, the eigenvalues of various dilute fast assemblies can be evaluated with a maximum error of 0.7%. The conclusions were made: The modal combining coefficients can be estimated by measuring the spectral index, and the suitable combination of reactions for the purpose is the set $\nu\sigma_f$ of ^{238}U/$\nu\sigma_f$ of ^{235}U. The coefficients of importance spectra can be evaluated by measuring the material worth on the basis of the first-order perturbation theory. Unknown mode constants and adjoint-weighted mode constants can be determined by measuring spectral indices and material worths, respectively, in various assemblies where the modal combining coefficients were determined in advance. The errors in the spectral indices and the material worths which are calculated by using these estimated mode constants are less than a few percent and some 10%, respectively. (auth)

58041 HEAT TRANSFER PROBLEMS AT SODIUM-COOLED FAST BREEDING REACTORS. Schultheiss, G. F. Energ. Atomtech.; 24: No. 4, 180-2(Apr 1972). (In Hungarian).

A short survey is given on the most important thermohydraulic data of sodium-cooled fast breeder reactors. The problems of designing this kind of reactor are outlined and illustrated. Emphasis is on the troubles of cooling medium flow. The trouble of cooling medium flow through fuel elements and the following boiling of the cooling medium are investigated in two cases: full blockade of a fuel element, and local troubles arising inside a fuel element spreading to only a few subchannels. Finally, a survey is given of the theoretical and experimental works dealing with these problems. (19 references) (auth)

Control and Instrumentation

58042 (EURFNR–1033) CONTROL ROD EXPERIMENTS IN SNEAK-ASSEMBLY 6. Pilate, S.; Plum, F. (comps.) (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Systemtechnik und Reaktorphysik). Jul 1972. 79p. (KFK–1633). Dep. NTIS (U. S. Sales Only).

Work Performed under United States–Euratom Fast Reactor Exchange Program.

The results of evaluation of the control rod experiments performed in the SNEAK-6 program (February–September 1970) are summarized. The control rod materials investigated were B_4C, Na, Ta, Al and steel. A simulated rod, made of two parts, absorber and follower, was partially or totally inserted in the core at the center of the plutonium zone. Reactivity changes and power traverses were measured. This program was a continuation of a first control rod campaign performed in the assembly SNEAK-2, part C. 9 references. (auth)

58043 QUALITY ASSURANCE REQUIREMENTS FOR THE INSTALLATION, INSPECTION, AND TESTING OF INSTRUMENTATION AND ELECTRIC EQUIPMENT. Safety Guide 30 1972. Washington, D. C.; Directorate of Regulatory Standards, AEC (1972). 3p.

This safety guide describes an acceptable method of complying with the Commission's regulations with regard to the quality assurance requirements for the installation, inspection, and testing of nuclear power plant instrumentation and electric equipment, in accordance with 10 CFR 50. (TSS)

Containment Systems, Waste Processing, and Radiation Protection

58044 DEVELOPMENTAL TRENDS IN THE CONSTRUCTION OF LARGER PRESSURE VESSELS FOR NUCLEAR REACTORS. Schlosser, Kurt (Reactor Center, Seibersdorf, Austria). Elektrotech. Maschinenbau; 88: No. 8, 336-41 (1971). (In German). (SGAE-RT-30/1970).

The trend toward larger nuclear reactors, coupled with higher temperatures and coolant pressures, creates a demand for ever larger pressure vessels. The advantages of steel pressure vessels built in the shop are contrasted with those built on site. Radiation testing of thicker steel walls requires more specialized equipment, since picture contrast and recognition of failures is much more difficult; 50 to 500 mm steel needs an 8-MeV linear accelerator for such investigation. The great advantages of prestressed concrete are discussed: in-place construction, simpler testing, and lessened need for outer containment. Multilayer steel vessels have numerous advantages over single-layer construction. Pressure vessels for future nuclear reactors will likely be either prestressed concrete or multilayered steel. (K.S.W.)

58045 CRITERIA FOR REINFORCED CONCRETE NUCLEAR POWER CONTAINMENT STRUCTURES. ACI STANDARD TITLE NO. 69-2. J. Amer. Concr. Inst.; 69: No. 1, 2-28(Jan 1972).

Design criteria are presented to serve as a guide in the design of reinforced concrete nuclear power containment structures. The philosophy of these structures in general is described and various factors to be considered in the design are outlined. Specific information on design and analysis methods, on load factors, and on allowable stresses and strains are included. Special material requirements pertaining to the construction of nuclear structures, such as ductility, splices, prestressing, corrosion protection, and others are considered. Special requirements of documentation and testing, such as preservation of records, performance of leak tests, and weld inspections, etc., are listed. These criteria were prepared by Committee 349 over a period of 6 years, and are based on the experience gained in the design and construction of nuclear power plants. They are released to the profession as a recommended practice. It is intended to eventually make these recommendations a part of the ASME Boiler and Pressure Vessel Code. (auth)

Coolant System

58046 (AECL–4261) LATREP–PERIGEE SIMULATION OF NPD. Phillips, G. J. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Sep 1972. 55p. Dep. NTIS (U. S. Sales Only). AECL \$1.50.

A computer simulation of the Nuclear Power Demonstration Reactor (NPD) which demonstrates the ability of the CRNL cell code LATREP to predict the burnup of natural uranium fuel in a CANDU type lattice over an extended irradiation and under power reactor conditions was developed. The simulation covers the first six years of NPD operation, which included the equivalent of almost 1500 days at full power. The calculations were performed using the cell code LATREP, the core code PERIGEE, and a number of auxiliary codes. During most of the simulation, the calculated excess reactivity averaged +1.5 milli-k, i.e., a difference of 0.15% from the observed value. The calculated exit irradiation is equivalent to a fuel burnup of 6840 MWd/teU, compared to a value of 6850 MWd/teU from the observed fueling rate. Data used in the simulation, and most of the details of the calculations are included in appendices. (Canada)

58047 (BAW–10037(Rev.1)) REACTOR VESSEL MODEL FLOW TESTS. Revision 1 (Nonproprietary Version of BAW–10012). Mullinax, B. S.; Walker, R. J.; Karrasch, B. A. (Babcock and Wilcox Co., Lynchburg, VA. (USA). Nuclear Power Generation Div.). Sep 1972. 75p.

Hydraulic tests on a one-sixth-scale model of a two-loop pressurized water reactor with 177 fuel assemblies are described. Core inlet and outlet flow distribution, vessel pressure drop, gross mixing of the fluid entering the core and within the core, and vent valve closing forces were investigated. The core inlet flow distribution was found to be highly dependent on the flow conditions in the inlet annulus and the thermal shield regions. A distribution system consisting of several flow baffles was developed to obtain a uniform and stable core inlet flow distribution. A uniform core outlet flow distribution similar to the inlet distribution was established by placing a turn-around baffle between the core outlet and the outlet nozzles. Gross mixing results showed that the fuel assemblies at the periphery of the core receive most of their flow from the closest vessel inlet. Improvement of flow distribution from the vessel inlet to the core inlet and modifications of the upper turn-around baffle reduced the vessel pressure losses by 18%. A positive closing force is imposed on the reactor vent valves during normal operation, regardless of the opening angle of the valve. Modification of the reactor internals for the two-loop 177-fuel-assembly plant resulted in changes to several components that were developed to optimize the reactor coolant flow distribution. The results of an experimental program to investigate the hydraulic characteristics of the modified reactor vessel internals are presented. (auth)

58048 (JAPFNR–40) SODIUM FLOW TEST RESULTS FOR A SIMULATED CORE FUEL SUBASSEMBLY OF THE EXPERIMENTAL FAST BREEDER REACTOR "JOYO". (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Translation of report PNC-N–141-72-1-10. 11p. Dep. NTIS (U. S. Sales Only).

Simulated flow tests in a full size mockup of a Joyo Reactor fuel subassembly were made with liquid sodium correlations between simulation test results and calculated parameters were good. (J.M.J.)

58049 (JAPFNR–42) SODIUM BOILING TEST LOOP AND TEST RESULTS. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Translated from report PNC-N–141-72-1-12. 5p. Dep. NTIS (U. S. Sales Only).

Experimental apparatus for a mockup study of sodium boiling in the Joyo Reactor core is described. Thermal and hydraulic phenomena occurring in sodium boiling were observed. (J.M.J.)

58050 (JAPFNR–46) PRELIMINARY DESIGN FOR INPILE LOOP IN "JOYO" MK-II. (Mitsubishi Atomic Power Industries, Inc., Omiya (Japan)). Translation of report PNC-N–141-72-1-17. 5p. Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan).

The inpile loop, designed for the Joyo Reactor, is described briefly. (J.M.J.)

58051 (JAPFNR–49) DEVELOPMENT OF COMPONENTS AND SODIUM TECHNOLOGY. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Translation of report PNC-N–141-72-1-20. 7p. Dep. NTIS (U. S. Sales Only).

Development of cooling system components for the Joyo Reactor is discussed, and component development schedules are presented graphically. Some problems of corrosion in liquid sodium are mentioned briefly. (J.M.J.)

58052 (TID–3334(Pt.1)) SODIUM TECHNOLOGY, 1948–1961. (Technical Information Center (AEC), Oak Ridge, Tenn.). Sep 1972. 186p. Dep. NTIS.

A bibliography on all aspects of the use of liquid sodium and NaK as reactor coolants is presented. Included are annotated abstracts of all pertinent references cited in Nuclear Science Abstracts (NSA) from 1948 through 1961 inclusive. A subject index is included. (J.M.J.)

58053 OPERATIONAL BEHAVIOR OF A PRECIPITATION CYCLONE FOR STEAM/WATER SEPARATION. Graebener, K.-H. (AEG-Telefunken, Grosswelzheim, Ger.). Brennst.-Waerme-Kraft; 24: No. 5, 196-200(May 1972). (In German).

Steam separators separate the steam—water mixture generated in the core of a boiling water reactor. The reflux water must be free of steam and the separated steam should carry as few water droplets as possible. The newly developed separator, which is arranged above the reactor core and consists of a number of cyclones, achieves this objective. The large-scale tests necessary for the development are described, particularly the instrumentation used for measurements in the two-phase flow and the methods used to measure moisture content and reverse flow of the steam and pressure differentials. The test results are applied to the operation of a reactor and presented as a function of the load and compared with known separator concepts of more traditional design. (auth)

Fuels and Fuel Elements

58054 (EURFNR–968, pp 15-21) COMPUTER PROGRAM BRAV. Depisch, F.

The computer program BRAV provides data on the performance of fast reactor fuel rods as a function of service life. The program permits the optimization of various characteristics such as maximum rod power and thermal expansion limits. (D.C.C.)

58055 (EURFNR–968, pp 22-7) COMPUTER PROGRAM FTB-4. Wordsworth, J.

The computer program FTB-4 (fuel thermal behavior, version 4) provides data on the performance of fast reactor fuel rods. The program is used on the CDC-6400 computer. 6 references. (D.C.C.)

58056 (EURFNR–968, pp 52-7) COMPUTER PROGRAMS LIFE AND ISUNE 1. Depisch, F.; Elbel, H.

The LIFE computer program is designed to analyze the optimum performance of fast reactor fuel rods. The ISUNE 1 computer program calculates the temperature distribution, thermal stresses and burnup characteristics of fast reactor oxide fuel pins. 6 references. (D.C.C.)

58057 (EURFNR–968, pp 74-80) COMPUTER PROGRAMS CANNING AND CRASH. Closs, K. D.

The computer program CANNING uses conservative assumptions to solve the fundamental equations for the multiaxial creep deformation of a canning tube and therefore determines the necessary length of the fission gas plenum as a function of wall thickness and burnup for fuel element cans in fast liquid metal cooled reactors. The CRASH computer program calculates the stresses and strains for a given fuel can geometry without major simplifications over the entire lifetime in a can. 3 references. (D.C.C.)

58058 (EURFNR–968, pp 184-200) EXPERIMENTAL FINDINGS ON HEAT TRANSFER BETWEEN FUEL AND CAN. Schmidt, Hans-E.

An important parameter for the calculation of fuel rod temperatures is the fuel/can heat transfer coefficient. For a given rod power and can inner radius, it determines the height of the temperature gradient between the inner wall of the can and the surface of the fuel. The heat transfer between the fuel and can has been examined both in the laboratory and directly in the reactor by numerous authors. For oxide fast breeder rods heat transfer coefficients of between 0.5 and 1.5 $W/cm^2/°C$ were measured under realistic fabrication and operating conditions, from which temperature surges of between 600 and 200°C can be calculated on the basis of a rod diameter of 5.2 mm and a linear rating of 500 W/cm 20 references. (auth)

58059 (JAPFNR–31) FUEL DESIGN OF JOYO. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Translated from report PNC-N–141-72-1-1. 5p. Dep. NTIS (U. S. Sales Only).

Summaries of the design parameters and design criteria for the Joyo Reactor fuel elements are presented in two tables. (J.M.J.)

58060 (JAPFNR–32) DESIGN BASES FOR "MONJU" FUEL PIN. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Translated from report PNC-N–141-72-1-2. 5p. Dep. NTIS (U.S. Sales Only).

A summary of the design criteria for the Monju Reactor fuel pins is given. (J.M.J.)

58061 (JAPFNR–58) INTERNAL PRESSURE FATIGUE TEST ON FUEL CLADDING FOR EXPERIMENTAL FAST REACTOR JOYO. Iizuka, T.; Kusumoto, A.; Maki, H.; Hara, T.; Sato, M. (Hitachi, Ltd., Tokyo (Japan)). Translation of a Japanese report. 67p. (PNC-J-202-71-10). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan).

Fatigue testing under internal pressure has been carried out to obtain allowable stress. The testing was performed under internal pressure and at temperatures of 600, 650 and 700°C under constant temperature and under cycling temperature synchronized with internal pressure. As a result, fatigue curves up to about 3,000 cycles were obtained and there were not significant differences between the strength at a constant temperature and that under thermal cycling. (auth)

58062 (NP–19435, pp 39-61) MATERIALS.
Research was conducted on nuclear fuels and matrices (UO_2 core with pyrocarbon or silicon carbide coatings). Irradiation tests were carried out on Gilsocarbone graphite intended for power reactors and on fuel pellet matrices. In-pile irradiation tests were performed on fuels and the quality control prior to irradiation are reported. (France)

58063 (NP–19435, pp 65-103) REACTOR TECHNOLOGY.
During the past year emphasis was put on the study of the Dragon reactor, itself, and a high temperature power reactor project, the fuel pins of which are arranged in a telephone dial configuration (reactor kinetics, control, and safety). Computations already initiated on certain reactor physics experiments were continued. (France)

58064 (NP–19435, pp 107-18) TECHNICAL SERVICES.
The activities of the technical series were reoriented in conjunction with the needs of the Dragon project (new core system for fuel pin studies); a documentation system for the dissemination of the information obtained from the various irradiation experiments; and withdrawal of irradiated and nonirradiated fuel. (France)

58065 FAST REFUELLING SYSTEM FOR BWRs. Nucl. Eng. Int.; 17: No. 193, 490-1(Jun 1972).
An outline is given of a streamlined BWR refueling system to be introduced in the Forsmark I plant, which will permit refueling during a weekend shutdown. Economic advantages are discussed. (UK)

58066 EXPERIMENTAL INVESTIGATION OF FUEL ELEMENT STRESS BY A BOILING TECHNIQUE. Cramer, M.; Dorr, B. (Nuclear Research Center, Karlsruhe, Ger.). KFK Nachr.; 3: No. 2, 17-21(1971). (In German).
A tank 0.6 m in diameter and 8.3 m high contained in its lower end a pool of molten sodium, in which was immersed an electrically heated rod simulating a prototype reactor fuel element surrounded by dummy elements. Protection from sodium fires was obtained with an external nitrogen blanket. Boiling of the liquid sodium could be obtained by either heating under constant pressure, or by dropping the pressure rapidly. Pressure surges and temperature excursions were recorded during the boiling periods. Subsequent dimensional measurements indicated that no deformation occurred as a result of the tests. (K.S.W.)

58067 EVALUATION OF A NEAR-BREEDER, LOW COST, LWR CONCEPT. Zorzoli, G. B. (CISE, Milan). Energ. Nucl. (Milan); 19: No. 3, 151-61(Mar 1972).
The consequences from the use of thorium metal as a LWR fuel are analyzed. The case of the replacement of UO_2 fuel in a PWR with Th metal fuel having the same geometrical characteristics is studied. The possible benefits obtained are discussed. 32 references. (auth)

58068 DEVELOPMENT OF SODIUM MACHINERY AND EQUIPMENT AND TESTING APPARATUS FOR FAST-BREEDER REACTOR. Ogushi, Kozo; Hayakawa, Shigeru (Fuji Electric Co. Ltd., Tokyo). FAPIG (Tokyo); No. 62, 90-4; 104(Aug 1971). (In Japanese).
The sodium-cooled fast breeder reactor is one of the promising second-generation reactor types for nuclear power generation. There are, however, considerable unsolved problems including sodium technology, and it is difficult to directly apply conventional nuclear techniques. To solve this, research and development were done using three sodium equipment: miniloop, one-inch loop and three-inch loop. In the miniloop, operation tests of fine mechanism parts were performed in high-temperature liquid sodium and in gas phase containing sodium vapor. The one-inch loop and three-inch loop were used for development of grasping mechanism in fuel exchange gear and of fuel channel failure detection system, respectively. A few process instruments such as flow meters and thermometers and sodium pumps are now under investigation. (Japan)

Auxiliary Systems and Engineered Safeguards

58069 GENERAL STRUCTURAL DESIGN CRITERIA FOR PWR CONTAINMENT-INTERIOR STRUCTURES. Sihweil, Isa S. (Bechtel Corp., San Francisco). Nucl. Safety; 13: No. 5, 373-9(1972).
The containment-interior structures of pressurized-water reactors have several safety functions for which their structural integrity is of utmost importance. By providing support during plant operation and postulated earthquakes, they help prevent the occurrence of a loss-of-coolant accident. Furthermore, if an accident does occur, they help mitigate its consequences by protecting the containment and all the provided engineered safety features from jet forces, whipping pipes, differential pressures, and missiles. The problems and complexity of combining system and structural requirements in arriving at a conservative and yet economical design warrant a general discussion of the criteria involved and of the special dynamic structural problems encountered. (auth)

58070 DEVICE FOR DETECTION AND LOCATION OF FAILED NUCLEAR FUEL ELEMENTS. Nybo, Sigurd A. (to Westinghouse Electric Corp.). U. S. Patent 3,666,625. 30 May 1972. Filed 16 Dec 1969.
Apparatus for testing for nuclear fuel element cladding failures comprises a device such as a magnetic member suspended within the gas plenum of a clad nuclear fuel element. When a cladding failure occurs, water or ambient fluid diffuses into the plenum and reacts with the device to cause a physical displacement of the device. Means are provided for locating a change in the position of the device and thereby detecting the cladding failure. Also provided is a material for absorbing moisture in a clad nuclear fuel element. (Official Gazette)

Operation and Economics

58071 (NP–19435) TWELFTH ANNUAL REPORT, 1970–1971. OCDE Project for the High Temperature Reactor: DRAGON. (European Nuclear Energy Agency, Paris (France)). 162p. (In French). Dep. NTIS (U. S. Sales Only).
Separate abstracts were prepared for each of the five sections of this progress report. (J.M.J.)

For abstracts of individual sections see: 58062—58064, 58072, and 58073.

58072 (NP–19435, pp 23-36) REACTOR OPERATION.
The conditions under which the reactor has been operated during the past year are reviewed. The various experiments performed are briefly described: irradiation of the third and fourth load; chemical studies concerning the primary (helium) loop; fission product behavior; operation and maintenance of the reactor cooling and reactor fueling installations; safety; and facility for testing the reactor components in a helium atmosphere. (France)

58073 (NP–19435, pp 121-62) ADMINISTRATION.
The members of the staff and the personnel representing the various member countries are presented. The work effected by the different committees in the fields of management, the establishing of contracts, and financing and accounting are briefly reviewed. (France)

58074 PEAK POWER SUPPLY FROM NUCLEAR POWER PLANT. Halzl, Jozsef; Szabo, Zoltan; Szucs, Laszlo; Torma, Miklos. Energ. Atomtech.; 23: No. 8, 357-64(Aug 1970). (In Hungarian).
In certain systems the high share of nuclear power plants may require that their design ensure suitable flexibility in electricity generation. Determining the operation of nuclear power plants requires the consideration of their specific investment cost, and secondary nuclear fuel production. From the point of view of peak load coverage by nuclear power plants there is an optimum utilization which includes district heating nuclear power plants and sea-water desalination. (auth)

58075 CAMAC SYSTEMS AT THE ATOMIC ENERGY ESTABLISHMENT WINFRITH, DORSET, ENGLAND. Keats, A. B.; Collins, G. B. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). CAMAC Bull.; No. 4, 20-2(Jul 1972).
The capability of two on-line computer systems using CAMAC interfaces at the AEEW is described. One is concerned with plant dynamic measurements, and requires occasional interface reconfiguration. The second is for the automation of a radioactive sample analysis laboratory controlled by a Honeywell H 316 computer. A third system is under development, in which a CAMAC interface is being implemented in parallel with an existing interface on a Ferranti Argus 500 computer. The architecture of the

Ferranti–CAMAC dataway is outlined, and its application described. (EURATOM)

Safety and Siting

58076 (KFK-EXT–8/71-2) REPORT ON THE CHECKING OF SOME TESTS FOR THE SIMULATION OF SEVERE HYPOTHETICAL ACCIDENTS IN FAST REACTORS AT THE TREAT REACTOR. Kuczera, B.; Struwe, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Aug 1971. 12p. (In German). INIS.

During the TREAT series of experiments for the model simulation of severe hypothetical accidents for fast reactors, very small mechanical conversion factors were found. One possible explanation for these small values could be, that all the sodium was expelled from the heated zone of the pins before the pins burst. Calculations with TIGER and RADYVAR 2 for the experiments S3 and S4 (very critical in this sense) have shown that in all probability the sodium has not been expelled from the heated zone before the pins burst. There are some difficulties in translating the measured small mechanical conversion factors of the TREAT experiments to the situation of a fast breeder reactor (e.g., SNR) because of the very different geometrical situation for the model simulation and the situation of a fast breeder reactor. (auth) (GF)

58077 (ORNL-NSIC–82) CHEMICAL AND PHYSICAL PROPERTIES OF METHYL IODIDE AND ITS OCCURRENCE UNDER REACTOR ACCIDENT CONDITIONS (A SUMMARY AND ANNOTATED BIBLIOGRAPHY). Parsly, L. F. (Oak Ridge National Lab., Tenn.). Dec 1971. Contract W-7405-eng-26. 117p. Dep. NTIS.

An extensive annotated bibliography on methyl iodide is presented that covers physical and chemical properties, chemical reactions, behavior under radiation, absorption, and trapping. The occurrence of methyl iodide in containment experiments and accidents is discussed. (auth)

58078 (ORO–4313-1(Rev.)) FUEL COOLANT INTERACTION IN LMFBR ACCIDENT ANALYSIS. First Quarterly Progress Report for the Period December 15, 1971–March 14, 1972. (Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences). Mar 1972. Contract AT(40-1)-4313. 41p. Dep. NTIS.

Three FCI computer codes — ANL-FCI, SOCOOL-II, and MFCDYN — were made operational on the U. Va. CDC-6400 computer. Working with Regulatory, a series of calculations and parametric variations for upper-limit type HCDA's for a typical small (~1000l core) LMFBR was proposed. One such calculation was carried out using the ANL-FCI code, although the work energies obtained were probably unrealistically high since no mixing time and no acoustic constraint were used. A preliminary examination of the S-series and L-I tests at TREAT was made to assess their relation to the FCI analytical models. (7 references) (auth)

58079 (TID–25975) ASME CODE QUALITY ASSURANCE PROGRAM FOR NUCLEAR REACTORS. McGuffey, J. R. (Oak Ridge National Lab., Tenn.). 1971. 9p. (CONF-720832–2). Dep. NTIS.

From third inter-American conference on materials technology; Rio de Janeiro, Brazil (14 Aug 1972).

To enhance the safety and reliability of vessels, pumps, valves and piping used in nuclear power systems, the ASME Boiler and Pressure Vessel Code has set forth specific quality assurance responsibilities for the owner, the manufacturers, the installers, the ASME and the authorized inspection agencies. In particular, the manufacturers and the installers of such components must operate under a controlled manufacturing system and have detailed quality assurance programs. This approach to controlling the design, fabrication and installation of nuclear components during the past three years has materially improved the integrity of nuclear pressure-boundary and pressure-containing systems. The ASME nuclear quality assurance program has proven so successful that those involved in procuring equipment for the chemical, petroleum, and conventional steam boiler industries may find it advantageous to set forth comparable requirements in design and construction specifications and codes. (auth)

58080 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Sheldon, Myrtleen. Nucl. Safety; 13: No. 5, 409-15(1972).

Progress summaries of water reactor safety studies are given under the following headings: integrity of primary systems; loss of coolant and emergency core cooling; containment integrity and siting; and reliability, standards, guides and codes. (M.C.G.)

58081 TRANSIENT SEISMIC ANALYSIS OF HTGR NUCLEAR POWER PLANTS. Jeng, David C. (Gulf General Atomic Co., San Diego, Calif.). Nucl. Eng. Des.; 21: No. 3, 358-67(1972).

Analytical procedures, which were employed in transient seismic analysis of high-temperature gas-cooled reactor (HTGR) nuclear power plants, are presented. A numerical example based on transient analysis of a typical 1100-MW(e) HTGR nuclear steam supply system is included. Three-dimensional transient seismic analysis of complex HTGR systems can be easily implemented. The method presented is applicable to dynamic analysis of a wide class of linear discrete structural systems. (auth)

58082 STUDIES AT KARLSRUHE ABOUT THE SAFETY OF THE SNR. Dmify, F. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt. Atomtech.; 17: No. 7, 375-8(Jul 1972). (In German).

Safety requirements for fast sodium-cooled reactors necessitate complete control of disturbances in the cooling system and in reactor activity. Safety problems were studied by various institutes of the Karlsruhe Nuclear Research Center since 1967. Disturbances of cooling in the total core as well as local disturbances were emphasized. Results showed that a far-reaching activity release into the environment can occur neither in hypothetical disturbances affecting the total core with subsequent excursion nor in local disturbances. (tr-auth)

58083 FAST REACTOR SAFETY. Graham, John. Nuclear Science and Technology. A Series of Monographs and Textbooks. New York; Academic Press, Inc. (1971). 384p. $18.00.

Information concerning safety aspects of the fast breeder power reactor is presented. A discussion of neutron kinetics, thermal analysis, feedback, closed-loop behavior, and fault tree analysis is included. Analysis of safety criteria for fast reactors is presented. Licensing requirements and siting considerations are discussed. (D.C.C.)

58084 INFORMATION SYSTEM FOR REACTOR SAFETY. GOAL AND POSSIBILITIES. Schlechtendahl, E. G.; Schultheiss, G. F. (Nuclear Research Center, Karlsruhe, Ger.). KFK Nachr.; 3: No. 2, 22-5(1971). (In German).

Problems of establishing a reactor safety information system are discussed, and a projected time plan for its completion is outlined which would require about six years. The mechanics of the data input to the data bank are outlined from the information surveyor to the microfilm stage. Technical handling and classification of information peculiar to reactor safety are considered. (K.S.W.)

58085 SOME STUDIES FOR ASEISMATIC DESIGN OF ATOMIC POWER EQUIPMENT. Ochiai, Kanehiro (Hitachi Ltd., Ibaraki, Japan): Kaga, Makio; Shiga, Motohiro. Hitachi Hyoron; 53: No. 11, 1116-19(Nov 1971). (In Japanese).

In many fields at present, countermeasures against earthquakes are emphasized. This is more so in design of nuclear power plants, which requires cautious and rigorous treatment. Dynamic analysis of earthquake response is now possible by means of electronic computers, and it brought remarkable advances in the field. Since nuclear power plants are complicated, many experiments are necessary to make more exact analysis and prove theories. In Hitachi, Ltd., such studies have been made in the past ≥10 years. Experiments performed in recent years on BWR power plants, are described on the following: reactor internal components (basic vibration studies in water, and vibration experiment with shroud models); fuel assemblies and control rods; and response analysis for piping systems (studies with small models, and beam model receiving multi-input excitation). (Japan)

Steam and Power Conversion System

58086 (BAW–10027(Suppl.1)) ONCE-THROUGH STEAM GENERATOR RESEARCH AND DEVELOPMENT REPORT. Supplement 1: Integral Economizer OTSG. McDonald, B. N.; Post, R. C.; Scearce, J. S. (Babcock and Wilcox Co., Lynchburg, VA. (USA). Nuclear Power Generation Div.). Sep 1972. 24p.

The research and development efforts carried out in support of the design of the commercial nuclear steam generator, the once-through steam generator (OTSG), are summarized in topical report BAW-10027, "Once-Through Steam Generator Research and Development Report." This supplement describes the additional research and development work that has been performed in support of the design of B&W's second-generation commercial nuclear steam generator, the integral economizer once-through steam generator (IEOTSG). (auth)

58087 (JAPFNR–53) FLOW DISTRIBUTION ANALYSIS OF ENTRANCE NOZZLE ORIFICE HOLES FOR "JOYO" CORE FUEL SUBASSEMBLY. Masuda, Seizo; Itoh, Arata; Ikeda, Kiyoshi (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa Prefecture (Japan)). Translation of a Japanese report. 44p. (PNC-J-201-71-18). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan).

An investigation of flow characteristics of a Joyo-type entrance nozzle with transverse multi-staged orifice-holes, which suck coolant into the core fuel assembly channel is described. (auth)

58088 CALCULATING THE OPTIMAL CHARACTERISTICS OF THE REHEATER FOR NUCLEAR PLANT TURBINES OPERATING ON SATURATED STEAM. Ponyatov, V. A.; Ostapenko, V. A.; Nikitin, V. P. (Saratov Polytechnical Inst., USSR). Therm. Eng. (USSR) (Engl. Transl.); 18: No. 2, 126-9(Feb 1971).

Translated from Teploenergetika; 18: No. 2, 85-7(Feb 1971).

Great attention is being paid at present to the design and manufacture of high capacity turbine plants for nuclear power stations (NPS), working on saturated steam. Characteristic features of these plants are the high moisture content during the expansion process, interseparation and steam reheating in a separator/reheater (S/R). Of great importance is an engineering and economic substantiation of the choice of dimensions for the separator/reheater since this affects the structural characteristics, efficiency, cost and layout of the turbine plant. An analytical method of determining the interrelationship between the optimal pressure losses and the minimum temperature head of the heating surface of a single-stage separator/reheater is presented. This simple layout is advisable for nuclear stations with boiling reactors in which use is made of standard low pressure cylinders (LPC) of presentday turbines. 6 references. (auth)

58089 LARGE NUCLEAR STEAM TURBINE-GENERATORS. Kato, Masatoshi; Shoyama, Etsuhiko; Hatori, Fumio; Hisano, Katsukuni (Hitachi Ltd., Ibaraki, Japan). Hitachi Hyoron; 53: No. 11, 1097-1102(Nov 1971). (In Japanese).

The recent construction program of nuclear power plants in Japan includes plants of 800-MW capacity and 1100-MW capacity. Turbo-generators used for these large-capacity nuclear power plants require design techniques and manufacturing facilities different from those for thermal power plants. The major differences are described in order to clarify characteristics of the large nuclear steam turbine-generators. At first, steam turbines are compared: The 1,300-MW capacity turbines of 1,500 and 1,800 rpm for nuclear power plants are based on the same technology as those for present thermal power plants. The structure of the turbines is different by adoption of shrinkage fit for low-pressure rotors; grooves on low-pressure moving blades, which are peculiar to GE-type nuclear steam turbines; peripheral chambers for all stages to capture water droplets; single casing and so on. Then turbine auxiliaries are compared, with the following differences: Deaerators are not provided in BWR systems, and condensers are designed to function on behalf of them. Air ejectors are to deal with hydrogen and oxygen disintegrated in reactors. Condensate water demineralizers of 100% capacity have to be provided. As for generators, stators reduce their weight by 20%; spring mounting of the stators becomes unnecessary; rotors weigh 2.2 times as much as that for thermal power plants, critical speed rises, magnetizing capacity decreases to 60%, and direct cooling of rotor windings by radial hydrogen flow is applied in four-pole nuclear power generators; and transient stability is a little poorer. (Japan)

Commercial Power Reactors

Refer also to abstract 58408.

58090 (NP–19411) NUCLEAR ENERGY FOR A NEW TOWN. Hammerschlag, Dieter; Rose, Vincent C. (Rhode Island Univ., Kingston). Aug 1971. 60p.

The problems of urban development, growth, and the effects of chemical and biological pollution and waste heat are treated. The need for both industrial development and cheap electric power while maintaining an environment of unspoiled nature is argued. The economics of nuclear vs fossil fuel power plants is considered. Commercial use of waste heat for industrial and sewage processing is proposed. All of the above are considered within the context of total community planning. (J.M.J.)

58091 (NP–19448) OSKARSHAMN NUCLEAR POWER PLANT. TECHNICAL INFORMATION. (Oskarshamnsverkets Kraftgrupp A.B., Stockholm (Sweden)). Jan 1972. 14p. (In Swedish). Dep. NTIS (U. S. Sales Only).

Oskarshamnsverket, Sweden's first commercial nuclear power plant, is briefly described. Information about owners, contractors, site, and buildings is given. Principal technical data about reactor components, fuel elements, turbines, electric generators, and radioactive waste disposal are given for the first two units. (FHS) (Sweden)

58092 (STI/PUB–194/5) POWER AND RESEARCH REACTORS IN MEMBER STATES. 1972 Edition. (International Atomic Energy Agency, Vienna (Austria)). Jul 1972. 72p. Dep. NTIS (U. S. Sales Only). IAEA $3.00.

A listing of power and research reactors, built, under construction, and planned, in the IAEA member states, is presented. Arrangement is by power or research reactor, separated by states (operation, under construction, or planned), and grouped together for each country. A reactor name index is included. (J.M.J.)

58093 (TID–26156) 1000 MW(e) MOLTEN SALT BREEDER REACTOR. CONCEPTUAL DESIGN STUDY. Final Report, Task I. (Ebasco Services, Inc., New York). Feb 1972. Contract W-7405-eng-26. 234p. Dep. NTIS.

For Oak Ridge National Lab., Tenn.

A conceptual design for a 1000 MW(e) molten salt breeder reactor system is presented. Included are designs for the reactor, steam-power conversion, fuel reprocessing, off-gas, and salt drain systems. (J.M.J.)

58094 AUSTRIA'S FIRST NUCLEAR POWER PLANT: TULLNERFELD. Com. Naz. Energ. Nucl., Notiz.; 18: No. 7, 46-9(Jul 1972). (In Italian).

Given are the history and description of the first nuclear power plant now under construction in Austria. (auth)

58095 RECENT PROGRESS IN BWR POWER PLANTS. Nakazaki, Toyoichiro (Hitachi Ltd., Ibaraki, Japan); Korei, Yoshiaki. Hitachi Hyoron; 53: No. 11, 1087-91(Nov 1971). (In Japanese).

Improvements in recent boiling-water-type reactors and characteristics of Jimmer-type reactors are described. Introduction of disposal systems for radioactive wastes developed by Hitachi Ltd. is added. The improvements are as follows: as initial loading fuel, fuel with gadolinia is adopted; and by using burnable poison, burn-up ratio and controllability of power distribution are improved. Secondly, fuel rods of low-enriched uranium and those of a little higher enriched one are arrayed on optimum combination. This arrangement can check local power peaking and makes reactivity control easy. The Jimmer-type reactor plants have the following three characteristics: (1) Throttle valves are adopted to control recirculating flow with improved load response. (2) Mark-II-type reactor containment is adopted which unites dry well and repression room in a body. (3) The new emergency core cooling system has a high-power core spray with high cooling ability in any event. The disposal equipment for radioactive wastes have three main parts: holding equipment for rare gases, burning and solidifying equipment for concentrated liquids, and incinerators. (Japan)

58096 CONSTRUCTION OF SHIMANE NUCLEAR POWER PLANT. Yakushiji, Kaoru (Chugoku Electric Power Co. Inc., Hiroshima); Saito, Ryozo. Hitachi Hyoron; 53: No. 11, 1092-6 (Nov 1971). (In Japanese).

Since its start in February 1970, ~60% of the construction has been completed in August 1971. Characteristics and situation of the construction of this plant are reported. This nuclear power plant has 1380 MW(t) and 465 MW(e). This plant has a low-pressure core injection system in addition to the common core spray system for higher reliability. Moreover, the core cooling system at the time of reactor isolation itself is made smaller than heretofore. Four independent buildings are provided for the reactor, turbine, control and disposal of radioactive wastes in this plant. As condensing and desalting equipment, filter-type and mixing-bed type equipment are adopted. Radioactive wastes are disposed separately in the forms of vapor, liquid, and solid. Construction is two months ahead of schedule. Installation of the containment vessel required only five months, including pressure test and leakage rate test, establishing a world record for shortest installation time. (Japan)

58097 KALKAR SNR: A DeBeNeLUX DESIGN FOR A 300-MWe FAST SODIUM REACTOR. Com. Naz. Energ. Nucl., Notiz.; 18: No. 6, 55-61(Jun 1972). (In Italian).

History and main specifications of the design for a 300-MW(e) fast sodium reactor now under construction at Kalkar, in cooperation between Germany, Belgium, Netherlands, and Luxembourg. Tabulations showing the nuclear power plants now in operation, under construction, or planned in Germany are included. (auth)

Physics and Core Engineering

58098 (BAW–10038) PROTOTYPE VIBRATION MEASUREMENT PROGRAM FOR REACTOR INTERNALS. 177-Fuel-Assembly Plant. Thoren, D. E.; Harris, R. J. (Babcock and Wilcox Co., Lynchburg, VA. (USA). Nuclear Power Generation Div.). Sep 1972. 35p.

In accordance with Safety Guide 20, a vibration measurement program to be used at the Oconee 1 reactor site has been developed. The details of the program and the plans for recording and analyzing the required data are described. (auth)

58099 (BAW–10051) DESIGN OF REACTOR INTERNALS AND INCORE INSTRUMENT NOZZLES FOR FLOW-INDUCED VIBRATION. Hooker, E. O. (Babcock and Wilcox Co., Lynchburg, VA. (USA). Nuclear Power Generation Div.). Aug 1972. 74p.

The redesigned reactor internals and incore instrument nozzles have been analyzed for operational, flow-induced loadings. The results of the analyses show that the reactor internals and incore instrument nozzles are structurally adequate for long-term operation. (5 references) (auth)

58100 (INIS-mf–201) THERMODYNAMIC DEVELOPMENTS IN BOILING WATER REACTORS. Imhoff, D. H.; Levy, S.; Schraub, F. A. (General Electric Co., San Jose, Calif.). 1971. 14p. (CONF-710317–8). INIS.

From sixteenth nuclear congress; Rome, Italy (25 Mar 1971).

Recent thermodynamic studies in support of the design and operation of large boiling water reactors are described: 1) Extensive steady-state critical heat flux tests in high-pressure water and Freon to validate and improve the critical heat-flux correlations employed for simplified and multirod geometries. 2) Transient critical heat flux experiments to establish the accuracy of analytical models used in safety analyses. 3) Local measurements of flow and enthalpy conditions in multirod geometries to develop increased understanding and improved predictions of critical heat-flux conditions. 4) Transient tests simulating loss-of-coolant accidents and the resulting pressure, water level, and decay heat removal during blowdown. 5) Spray and flooding experiments to verify the heat transfer behavior after the initial blowdown in a loss-of-coolant accident. In each of the above studies, the equipment and facilities are described first; next, the range of the conditions covered in the tests is discussed; and finally, a summary of the principal results is given. The application of the preceding laboratory thermodynamic work to reactor design and operation is considered by including typical examples of the thermodynamic results obtained in boiling water reactors which have gone into operation recently. Their satisfactory performance in terms of flow distribution and transient behavior is a reflection upon the merits and quality of the laboratory thermodynamic investigations. (GF)

58101 SIMULATION OF BWRs FOR CORE PERFORMANCE CALCULATIONS. Nakamura, Hideo (Hitachi Ltd., Ibaraki, Japan); Inaba, Gohzoh; Iida, Hiroshi; Miyagaki, Hisanori; Sugiyama, Sakae. Hitachi Hyoron; 53: No. 11, 1103-6(Nov 1971). (In Japanese).

In order to establish a process computer system in a hurry, on-line simulation of power plant and investigation and estimation of core performance calculation programs have been performed with a computer HITAC 5020. Contents and results of these simulation tests are reported. The core performance programs consist of 4 periodic programs and 20 on-demand programs. From the periodic programs, distribution of power, flow, and voids, etc. are obtained. The on-line core performance calculation programs (PCH) were made, and comprehensive performance estimation was made, using calculation results of three-dimensional diffusion code as input. Results by the PCH agreed well with those by the 3-dimensional diffusion code, and calculation method by the PCH was identified as excellent. The on-line computer system consists of a plant simulator and a process computer. The plant simulator has three simulators for reactor plant, signals of in-core monitor and reactor control panel. As the process computer, HITAC 5020 was adopted. A plant of Chugoku Electric Power Company was adopted as a model. By using this model, off-line calculation of stationary power condition and the on-line calculation by the periodic and on-demand programs were performed. As a result, this computer system was identified as adoptable for power plants. (Japan)

58102 EFFECTIVE BOOSTER ROD. Haga, Tohru (Hitachi Ltd., Kawasaki, Japan). Nucl. Sci. Eng.; 48: No. 2, 227-31(Jun 1972).

Consideration is given to the use of booster rods in a D_2O-moderated H_2O-cooled boiling-water power reactor to provide reactivity control to override ^{135}Xe buildup. A booster rod, generally containing highly ^{235}U-enriched uranium, is equivalent to a highly effluent fuel assembly. It is shown that the fuel distribution within the most effective booster rod is such that the fuel importance function is flat. Several models of booster rods are evaluated. (auth)

Control and Instrumentation

Refer also to abstract 58043.

58103 (BMBW-FBK–72-10) BWR-CONTROL. Braeuhaeuser, H.; Stephan, W.; Reinhardt, A.; Lockau, J.; Colmano, G.; Beckmann, H.; Gieseler, B.; Bokelmann, R.; Andersen, A.; Schmidt, U. (Allgemeine Elektricitaets-Gesellschaft, AEG-Telefunken, Frankfurt am Main (West Germany)). Aug 1972. 268p. (In German). Dep. NTIS (U. S. Sales Only).

A control system for a direct cycle boiling water power reactor, which is adaptable to the German power grid, is described. The design of the control elements is given. A digital computer program, to operate the reactor during transient and steady-state conditions, is developed. (auth)

58104 AUTOMATED GAMMA-SPECTROMETRIC SYSTEM FOR CONTROL OF PWR NUCLEAR POWER PLANTS. Loos, G.; Goerner, W.; Tschirne, G. (Deutsche Akademie der Wissenschaften, Berlin). Kernenergie; 15: No. 5, 161-4(May 1972). (In German).

The structure of an automatic measuring system developed for radiochemical and dosimetric control is described. Its tasks and functions are elucidated. A given version of radiochemical separation in groups has to be used for sample pretreatment in the analysis of complex isotope mixtures (fission and corrosion products in primary water coolant) and may be considered to be fit for routine measurements. (auth)

Containment Systems, Waste Processing, and Radiation Protection

58105 (AECL–4262) EXPERIENCE WITH ZIRCONIUM-ALLOY PRESSURE TUBES. Ross-Ross, P. A.; Evans, W.; Langford, W. J. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Aug 1972. 11p. Dep. NTIS (U. S. Sales Only). AECL $0.50.

Pressure tubes, which contain the fuel and coolant, are the pressure vessels of the Canadian designed CANDU nuclear reactor which basically consists of a large number of identical pressure tube assemblies. Zirconium alloys are used as tube material because of their good strength, good corrosion resistance, and low neutron absorption. The advantages of the pressure tube include simplicity of design, ease of fabrication, and development of inspection and testing methods with low investment costs. Because pressure tubes are relatively small, prototype tubes can be irradiated at full power reactor conditions in the test reactors. Their behavior is monitored periodically and finally they are removed for destructive evaluations. The results from strength, corrosion and other evaluations are applied to the design of tubes for power reactors, and to an assessment of their safety. In-reactor creep tests show that creep is enhanced by fast neutron flux, but also provide the information the designer needs to accommodate creep deformation. Canadian experience with pressure tubes is briefly described. Of major importance has been the tube irradiation program, which has provided the information and confidence needed to proceed with an ever expanding power reactor program. (Canada)

58106 (JPRS–56731 (pp 7-16)) SPECIAL DESIGN FEATURES OF RHEINSBERG NUCLEAR POWER PLANT SHIELDING WALLS. Gerullis, W.; Michaelis, U. E. Translated from Bauplanung-Bautech.; [26:] 285-8(Jun 1972). NTIS.

58107 LEAKAGE-RATE TESTING OF CONTAINMENT STRUCTURES FOR NUCLEAR REACTORS. ANSI N45.4-1972. Hinsdale, Ill.; American Nuclear Society (1972). 6p.

The provisions of this standard specify the practices and test requirements for the quantitative determination of leakage rates of containment structures for the housing of operating nuclear reactors. The provisions apply to containment structures for nuclear power, test, research, and training reactors, wherever a gastight containment structure is specified as a condition for operation. (auth)

58108 PRESSURE-TIME HISTORIES IN PRESSURE SUPPRESSION REACTOR CONTAINMENTS, COMPARISON BETWEEN THEORY AND EXPERIMENT. Brosche, D. (Technische Univ., Munich). Atomkernenergie; 19: No. 4, 301-6(Jul 1972). (In German).

Short-term pressure–time histories are discussed for pressure suppression systems of water-cooled power reactors following a loss-of-coolant accident at the primary system, which are important for containment design. Pressure–time histories calculated with the mathematical model ZOCO V are compared with experiments, showing good agreement between theoretical and experimental pressure-time histories and giving information about the phenomena occurring during the short-term pressure behavior in a pressure suppression system. (auth)

58109 SHEAR SLIP AND ITS INFLUENCE ON THE BEHAVIOUR OF A SLEEVE REINFORCED CIRCULAR PENETRATION IN A CONCRETE SLAB. O'Connell, J. M.; Hellen, T. K. (Berkeley Nuclear Labs., Eng.). Nucl. Eng. Des.; 21: No. 3, 331-8(1972).

The current series of gas-cooled reactors contain a number of circular penetrations set in the walls of the prestressed concrete pressure vessels. Methods of reinforcing these penetrations vary; in some instances a steel sleeve is used, in others bonded bars are preferred. Recent work has dealt with the stresses and deformations in the vicinity of penetrations reinforced with a steel sleeve or bonded steel rings. This paper shows how stresses and deformations in the vicinity of sleeve reinforced penetrations are influenced by "shear slip" or lack of bond between the concrete and steel sleeve. The "decoupling" facility of BERSAFE is used, and the method would be suitable for the study of many similar cases of lined openings occurring in engineering practice. (auth)

58110 PRESSURE SUPPRESSION CONTAINMENT FOR A LIQUID-COOLED NUCLEAR REACTOR. Ullrich, Walter; Lohse, Karl-Heinz; Leuteritz, Jochen; Zeitzschel, Gunter; Fassl, Robert (to Licentia Patent-Verwaltungs GmbH). U. S. Patent 3,668,069. 6 Jun 1972. Filed 9 Oct 1968.

The apparatus includes a safety container formed by a spherical pressure shell and a condensation chamber filled with water arranged within the safety container. The condensation chamber, which is annular in shape, is bounded on the outside by the safety container, on the inside by a cylindrical wall within the container, and at the top and bottom by annular ends respectively connecting the top and the bottom of the cylinder with the safety container. A plurality of condensation tubes is provided to pass through the upper end and extend into the water in the condensation chamber. The reactor pressure vessel of the nuclear reactor is located within the cylindrical wall and surrounded by a cylindrical biological shield. The diameter of the shield is less than the diameter of the cylindrical wall so as to form an annular passageway between the shield and the cylindrical wall from the calotte-shaped region of the safety container above, to the calotte-shaped region of the safety container below, the condensation chamber. (Official Gazette)

58111 NUCLEAR REACTOR VAPOR SUPPRESSING MEANS. Schluderberg, Donald C. (to Babcock and Wilcox Co.). U. S. Patent 3,666,622. 30 May 1972. Filed 13 May 1969.

An improvement is described in apparatus for suppressing vapor pressure buildup within a nuclear reactor containment due to an accident in a reactor system, such as a rupture of the primary coolant system, or other event which produces vapor within the containment. The improvement is in providing an upright tank, the lower end of which is open and immersed in a pool fluid, such as water, within the containment; and providing evacuating means connected to the other end of the tank to continuously maintain the surface level of pool fluid internally of the tank higher than the level thereof externally of the tank. Since the pool fluid externally of the tank is exposed to vapor produced as a result of a vapor-producing event, its surface level is lowered as pressure builds up within the containment, allowing the vapor to enter the tank and be condensed, thereby preventing the further buildup of vapor pressure within the containment. (Official Gazette)

58112 VAPOR SUPPRESSING MEANS FOR A NUCLEAR REACTOR. Schluderberg, Donald C. (to Babcock and Wilcox Co.). U. S. Patent 3,666,616. 30 May 1972. Filed 7 Jan 1970.

Apparatus is described for suppressing vapor pressure buildup within a nuclear reactor containment. It includes a storage tank having a quantity of fluid stored therein and provided with a rupture disk and associated apparatus for explosively activating a disk rupturing element to release the fluid from the tank and into the containment in response to a buildup in vapor pressure within the containment. (Official Gazette)

Coolant System

Refer also to abstracts 58114 and 58115.

58113 (BAW–10052) MULTINODE ANALYSIS OF SMALL BREAKS FOR B AND W's 2568-MWt NUCLEAR PLANTS. Parks, C. E.; Dunn, B. M.; Jones, R. C. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Sep 1972. 55p.

Multinode analyses were conducted for several small breaks in the reactor coolant system of nuclear plants with internal vent valves. The multinode blowdown code CRAFT, the cladding heatup code THETA 1-B, and the heat transfer code QUENCH were used to perform these analyses at a core power of 2568 MWt. Curves showing the parameters of interest are presented. The results indicate that the AEC Interim Acceptance Criteria are satisfied. (5 references) (auth)

58114 (RDT-E–3-1-T(6-72)) VERTICAL, CANNED OR WET MOTOR-DRIVEN, SINGLE-STAGE CENTRIFUGAL PUMP. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jun 1972. 24p. RSO.

This standard covers the requirements of a vertically mounted, single-stage, canned-motor or wet-motor, hermetically sealed centrifugal pump classified as a Class 1 pump as defined in NA-2131 of the ASME Boiler and Pressure Vessel Code (ASME Code), Section III, for service in light water cooled reactor systems. (auth)

58115 (RDT-E–3-3-T(7-72)) VERTICAL, SHAFT-SEALED, MOTOR-DRIVEN, SINGLE-STAGE CENTRIFUGAL PUMP. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jul 1972. 27p. RSO.

This standard covers the requirements for a vertically mounted, single-stage, shaft-sealed, electric-motor-driven, centrifugal pump classified as a Class 1 pump as defined in NA-2131 of Section III of the ASME Boiler and Pressure Vessel Code (ASME Code) for service in water-cooled reactor systems. (auth)

58116 (RDT-E–5-1-T(6-72)) PRESSURIZER FOR PRESSURIZED WATER REACTORS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jun 1972. 34p. RSO.

This standard delineates the requirements for design, fabrication, testing, and inspection of an electrically heated pressurizer for pressurized water nuclear reactors using either direct immersion or non-immersion type heaters. (auth)

58117 VARIABLE FREQUENCY MOTOR-GENERATOR SET FOR RECIRCULATION FLOW CONTROL SYSTEM. Kawamura, Takashi (Hitachi Ltd., Ibaraki, Japan); Akiyama, Takao; Kawashiro, Yasuo. Hitachi Hyoron; 53: No. 11, 1107-11(Nov 1971). (In Japanese).

Most remarkable feature of BWRs is that boiling occurs in core, and the reactors can be controlled rapidly by changing coolant flow. This is called intra-reactor recirculation flow control system, and is performed by revolution control of recirculation pumps. What is different from the flow control system for conventional pumps is that it must satisfy several special requirements for the reactors. Considering these requirements, motor–generator sets—combination of a cage rotor induction motor, a hydraulic coupling, and an ac generator—were put into practice as its power source. Characteristics of the machines were confirmed by computer analysis as well as by testing models in advance. Good performance in static and dynamic characteristics, speed stability, and start of the recirculation pumps were confirmed in factory test. This first motor–generator set will be installed for No. 1 reactor of Shimane nuclear power plant. (Japan)

58118 TRANSFER OF RADIOACTIVE ^{13}N, ^{16}N, AND ^{18}F ALONG THE LOOP OF THE VK-50 BOILING REACTOR. Veselkin, A. P.; Kizin, V. D.; Kobzar, I. G.; (and others). This paper was summarized in At. Energ. (USSR); 31: No. 2, 135(Aug 1971) as paper No. 512/6168. (In Russian).

Full copy of this paper is held by TIC.

Samples of reactor water and steam condensate from the loop were passed through an ion exchange column, and the activity of each isotope was measured in the cationic, anionic, and neutral forms. ^{16}N in the reactor water contained 10 to 15% cations, 85 to 90% anions, and no detectable neutral forms. In the steam, the ^{16}N is all in cationic form. Similar results were obtained for ^{13}N. Ammonia is dissociated and recorded as the ammonium cation. The ^{16}N activity in the steam is approximately proportional to the square of the reactor thermal power. The apparent distribution coefficient of the N isotope activity between the steam and the water varied from 0.2 to 0.6, with an average value of 0.32. All of the ^{18}F in the water and steam is in the anionic form, with an apparent distribution coefficient of 0.1 to 0.2. (D.L.C.)

58119 CONCEPT OF RADIOACTIVE CIRCUIT AND WASTE WATER PURIFICATION IN AN ADVANCED PWR NUCLEAR

POWER PLANT. Winkler, R. (VEB KKW Greifswald-Rheinsberg, Lehr- und Versuchskraftwerk, Rheinsberg, Ger.). Kernenergie; 15: No. 5, 156-60(May 1972). (In German).

Starting from operation experiences, experimental results, theoretical considerations, and recent international insight, a layout for a radioactive circuit and waste water purification plant is conceived taking a large advanced pressurized water reactor, application of boric acid, and regular load operation as the basis. Continuous purification of primary water coolant is not provided for. (auth)

58120 RECENT STATUS OF THEORETICAL AND PRACTICAL INVESTIGATIONS ON ACTIVITY BUILD-UP IN PRESSURIZED WATER REACTORS. Schulz, K. D. (VEB KKW Greifswald-Rheinsberg, Lehr- und Versuchskraftwerk, Rheinsberg, Ger.). Kernenergie; 15: No. 5, 138-43(May 1972). (In German).

A review of the status of knowledge on activity build-up in the primary circuit system of pressurized water reactors is given on the basis of literature data. Activity build-up is a problem of operation far from being governed by maintenance and servicing. Further knowledge of elementary processes seems to be necessary for making advances. (39 references) (auth)

58121 OPERATING EXPERIENCES WITH PRIMARY WATER COOLANT PURIFICATION IN A PRESSURIZED WATER REACTOR. Langecker, K.; Oertel, K. (VEB KKW Greifswald-Rheinsberg, Lehr- und Versuchskraftwerk, Rheinsberg, Ger.). Kernenergie; 15: No. 5, 144-7(May 1972). (In German).

Results of continuous purification of primary water coolant obtained in a low-pressure ion exchange plant at the WWER-2 reactor of Rheinsberg nuclear power plant are given and evaluated. The efficiency relative to corrosion products, water impurities, and fission products is considered for various filter filling materials and for the conditions using boric acid. (auth)

58122 COMPUTATION AND LIMITS OF PRIMARY WATER COOLANT PURIFICATION BY ANION EXCHANGE IN CASE OF BORIC ACID CONTROL. Bosholm, J.; Langecker, K.; Oertel, K. (VEB KKW Greifswald-Rheinsberg, Lehr- und Versuchskraftwerk, Rhinsberg, Ger.). Kernenergie; 15: No. 5, 148-52(May 1972). (In German).

Separation of chloride from boric-acid-containing waters by anion exchange are considered theoretically on the basis of the universal case of simultaneous effect of K_d and Q/c_0. Results are backed up by laboratory investigations and are applied to continuous purification of primary water coolant. Conditions for effective separation of chloride from primary water coolant are formulated. Requirements on chloride content of the resins are derived. (auth)

58123 TRITIUM IN PRESSURIZED WATER REACTORS. Langecker, K.; Graupe, H. (VEB KKW Greifswald-Rheinsberg, Lehr- und Versuchskraftwerk, Rheinsberg, Ger.). Kernenergie; 15: No. 5, 165-71(May 1972). (In German).

The fractions of the different tritium formation processes are considered mathematically for the case where boric acid is used in presurized water reactors. The computed values are compared with experimental results obtained during test operation of the Rheinsberg nuclear power plant using boric acid control. Moreover, conclusions are drawn for operation of a 500-MW(e) reactor under defined secondary conditions. (auth)

Fuels and Fuel Elements

58124 (NP-19451) NON-PROPRIETARY INFORMATION ON NUCLEAR FUEL PERFORMANCE. (Westinghouse Electric Corp., Pittsburgh, Pa.). 18 Sep 1972. 30p.

Tables and curves of performance characteristics of Westinghouse reactor fuels are presented. Proprietary information has been deleted from many of them. (J.M.J.)

58125 (SNE-101) ^{238}Pu PRODUCTION IN COMMERCIAL WATER REACTORS EXPERIMENTAL AND ANALYTICAL PROGRAM. Roach, Kenneth E.; Mullett, William L.; Brown, Gilbert M.; Maxwell, William A.; Turner, Stanley E.; Mitchell III, Walter (Southern Nuclear Engineering, Inc., Dunedin, Fla.). Feb 1972. Contract AT(29-2)-2741. 89p. Dep. NTIS.

A study to determine the feasibility of production of ^{238}Pu in commercial power reactors is described in detail. ^{237}Np targets were irradiated in the Connecticut Yankee Power Reactor. Design and fabrication specifications for the test target assemblies are described. (H.D.R.)

58126 STRENGTH INVESTIGATION OF FUEL-CHANNEL STRUCTURAL ELEMENTS OF BELOYARSK ATOMIC POWER PLANT REACTORS. Emel'yanov, I. Ya.; Shatskaya, O. A.; Rivkin, E. Yu.; Nikolenko, N. Ya. At. Energ. (USSR); 33: No. 3, 729-33(Sep 1972). (In Russian).

The results of an investigation of stress conditions, cyclic strength, and stress corrosion of reactor fuel-channel elements at the Beloyarsk Atomic Power Plant are presented. It is shown that the thermal-expansion compensators of the fuel channel are subjected to the greatest stress. It has been established that the cyclic strength of fuel-channel elements is satisfactory. Corrosion cracking can result in the failure of compensators and the welded joints of channel tubing. Recommendations are given for the elimination of such damage. (4 figures, 4 tables) (auth)

Auxiliary Systems and Engineered Safeguards

58127 (BAW-10003(Rev.2)) QUALIFICATION TESTING OF PROTECTION SYSTEM INSTRUMENTATION. Revision 2. (Babcock and Wilcox Co., Lynchburg, VA. (USA). Nuclear Power Generation Div.). Sep 1972. 19p.

A revision of part of Chap. 6 of BAW-10003, a previously issued report, is given. Presented are the most recent criteria for seismic testing of protection system instrumentation. (J.M.J.)

58128 USE OF IEEE STD 308-1971, CRITERIA FOR CLASS IE ELECTRIC SYSTEMS FOR NUCLEAR POWER GENERATING STATIONS. Safety Guide 32 1972. Washington, D. C.; Directorate of Regulatory Standards, AEC (1972). 6p.

General Design Criterion 17, ''Electric Power Systems,'' of Appendix A to 10 CFR Part 50, ''General Design Criteria for Nuclear Power Plants,'' requires that an onsite electric power system and an offsite electric power system be provided to permit functioning of structures, systems, and components important to safety. In addition, Criterion 17 contains requirements concerning system capacity, capability, independence, redundancy, availability, testability, and reliability of such systems. IEEE Std 308-1971 supplements the requirements of Criterion 17 by elaborating on implementation methods; however, some of the implementation details delineated in IEEE Std 308-1971 are potentially in conflict with Criterion 17. This guide identifies these conflicts and describes acceptable resolutions. (auth)

58129 MAIN ELECTRIC DIAGRAMS OF NUCLEAR POWER STATIONS. Beldowski, T.; Szarski, W. (Technical Univ., Warsaw). Elektronika.; 47: 264-8(1971). (In Polish).

Main electric diagrams of nuclear power stations and requirements concerning nuclear power station auxiliary supply are discussed. Examples of main diagrams of nuclear power stations likely to find application in Poland are given. (auth) (NSA of Poland)

Operation and Economics

58130 (AECL-4273) ESTIMATING CANDU FUEL COSTS. Segel, A. W. L. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Sep 1972. 19p. Dep. NTIS (U. S. Sales Only). AECL $0.50.

A method of estimating CANDU fuel costs is described. The equations are sufficiently generalized that the method can be applied to a new fabrication industry where the fabrication techniques, costs of buildings, equipment and labor, and financial practices differ from those in Canada. Once a reference design cost has been established, the method can be used to estimate the effect of fuel cost due to expansion of the industry, learning and design modifications. When applied to Canadian industry the method estimates the known fuel costs with adequate accuracy. It is also apparent that the low cost for CANDU fuel is due largely to the simple design and small number of components. Even when enriched, the cost of CANDU fuel is significantly lower than the cost of light-water reactor fuel. (Canada)

58131 (DOCKET-50003-132) INDIAN POINT STATION, UNIT 1. Malfunction of No. 13 Steam Generator Main Steam Stop Valve. (Consolidated Edison Co. of New York, Inc., New York). 4 Oct 1972. 2p. Dep. NTIS.

58132 (DOCKET-50010-118) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Semiannual Report, January 1–June 30, 1972. (Commonwealth Edison Co., Chicago, Ill.). 1 Sep 1972. 70p. (DOCKET-50237-260; DOCKET-50249-157). Dep. NTIS.

58133 (DOCKET-50010-119) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Radioactive Waste and Environmental Monitoring, Semiannual Report, January 1–June 30, 1972. (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). 15 Aug 1972. 151p. (DOCKET-50237-261; DOCKET-50249-158). Dep. NTIS.

For Commonwealth Edison Co., Chicago, Ill.

58134 (DOCKET-50010-120) DRESDEN NUCLEAR POWER STATION, UNIT 1. Radiolytic Gas in the Dresden Unit 1 Off-Gas Line. (Commonwealth Edison Co., Chicago, Ill.). 22 Sep 1972. 4p. Dep. NTIS.

58135 (DOCKET-50206-169) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. January 1972 Nondestructive Inservice Inspection. (Southern California Edison Co., Rosemead, Calif.). Jul 1972. 19p. Dep. NTIS.

58136 (DOCKET-50213-159) HADDAM NECK PLANT, UNIT 1. Operation Report No. 72-8 for the Month of August 1972. (Connecticut Yankee Atomic Power Co., Haddam). 25 Sep 1972. 12p. (NYO-3144-75). Dep. NTIS.

58137 (DOCKET-50219-215) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Deenergizing of a Backup Scram Solenoid. (Jersey Central Power and Light Co., Morristown, N. J.). 28 Sep 1972. 3p. Dep. NTIS.

58138 (DOCKET-50219-216) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Core Spray System Water Hammer Phenomenon. (Jersey Central Power and Light Co., Morristown, N. J.). 3 Oct 1972. 11p. Dep. NTIS.

58139 (DOCKET-50245-164) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Technical Specifications, Proposed Change. (Millstone Point Co., Hartford, Conn.). 22 Sep 1972. 5p. Dep. NTIS.

Revised technical specifications are presented concerning the integrated primary containment leak test. (D.C.C.)

58140 (DOCKET-50245-166) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Common Mode Failure of 120 Incore Power Range Detectors. (Millstone Point Co., Hartford, Conn.). 29 Sep 1972. 2p. Dep. NTIS.

58141 (DOCKET-50249-160) DRESDEN NUCLEAR POWER STATION, UNIT 3. Reactor Protection System Limit Switch on No. 4 Turbine Control Valve Inoperable. (Commonwealth Edison Co., Chicago, Ill.). 20 Sep 1972. 2p. Dep. NTIS.

58142 (DOCKET-50249-161) DRESDEN NUCLEAR POWER STATION, UNIT 3. Recalibration of High Flow Isolation Switches. (Commonwealth Edison Co., Morris, Ill. (USA)). 26 Sep 1972. 1p. Dep. NTIS.

58143 (DOCKET-50249-162) DRESDEN NUCLEAR POWER STATION, UNIT 3. High Flow Switches on the Isolation Condenser Out of Calibration. (Commonwealth Edison Co., Morris, Ill. (USA)). 25 Sep 1972. 1p. Dep. NTIS.

58144 (DOCKET-50254-123) QUAD-CITIES STATION, UNITS 1 AND 2. Semiannual Report, January 1-June 30, 1972. (Commonwealth Edison Co., Chicago, Ill.). 1 Sep 1972. 54p. (DOCKET-50265-117). Dep. NTIS.

58145 (DOCKET-50254-125) QUAD-CITIES STATION, UNITS 1 AND 2. Radioactive Waste and Environmental Monitoring, Semiannual Report, January 1-June 30, 1972. (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). 15 Aug 1972. 135p. (DOCKET-50265-119). Dep. NTIS.

For Commonwealth Edison Co., Chicago, Ill.

58146 (DOCKET-50254-126) QUAD-CITIES STATION, UNIT 1. Report of Valve Malfunction. (Commonwealth Edison Co., Cordova, Ill.). 25 Sep 1972. 2p. Dep. NTIS.

58147 (DOCKET-50254-128) QUAD-CITIES STATION, UNIT 1. Three Suppression Chamber to Drywell Vacuum Breakers Found to Have Incorrect Position Indication. (Commonwealth Edison Co., Cordova, Ill.). 3 Oct 1972. 2p. Dep. NTIS.

58148 (DOCKET-50255-103) PALISADES PLANT. Control Rod Drive Mechanisms Relubricated. (Consumers Power Co., Jackson, Mich.). 26 Sep 1972. 2p. Dep. NTIS.

58149 (DOCKET-50255-104) PALISADES PLANT. Failure of One Main Steam Stop Valve (CV0510). (Consumers Power Co., Jackson, Mich.). 29 Sep 1972. 1p. Dep. NTIS.

58150 (DOCKET-50261-111) H. B. ROBINSON UNIT 2. Residual Heat Removal System Modifications. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 20 Sep 1972. 14p. Dep. NTIS.

58151 (DOCKET-50261-114) H. B. ROBINSON UNIT 2. Refueling Operations. (Carolina Power and Light Co., Raleigh, N. C.). 27 Sep 1972. 5p. Dep. NTIS.

58152 (DOCKET-50263-154) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Environmental Monitoring and Ecological Studies Program, 1971 Annual Report. (Northern States Power Co., Minneapolis, Minn.). 5 Oct 1972. 478p. Dep. NTIS.

58153 (DOCKET-50271-104) VERMONT YANKEE NUCLEAR POWER STATION. Variance From Performance Specifications. (Vermont Yankee Nuclear Power Corp., Rutland). 29 Sep 1972. 1p. Dep. NTIS.

Information is presented concerning the malfunction of two solenoid operated isolation valves during a test of the containment air sampling system. (D.C.C.)

58154 (DOCKET-50271-106) VERMONT YANKEE NUCLEAR POWER STATION. Operations Report 72-7 for Month of July 1972. (Vermont Yankee Nuclear Power Corp., Rutland). 4 Oct 1972. 27p. Dep. NTIS.

58155 (DOCKET-50289-67) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Operating License Application, Amendment 29. (Metropolitan Edison Co., Reading, Pa.). 15 Sep 1972. 10p. Dep. NTIS.

58156 (DOCKET-50289-68) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Report on Containment Building Ring Girder Construction and Repair, Addendum 4. (Metropolitan Edison Co., Reading, Pa.). 22 Sep 1972. 10p. Dep. NTIS.

58157 (DOCKET-50298-52) COOPER NUCLEAR STATION. Supplemental Information on the Financial Qualifications of the Nebraska Public Power District. (Nebraska Public Power District, Columbus). 22 Sep 1972. 2p. Dep. NTIS.

58158 (DOCKET-50301-73) POINT BEACH NUCLEAR PLANT, UNIT 2. Start Up Testing Summary. (Wisconsin Electric Power Co., Milwaukee). 26 Sep 1972. 125p. Dep. NTIS.

58159 (DOCKET-50309-70) MAINE YANKEE ATOMIC POWER STATION. Class A Integrated Containment Leak Rate Test. (Maine Yankee Atomic Power Co., Westboro, Mass.). 28 Sep 1972. 45p. Dep. NTIS.

58160 (DOCKET-50346-35) DAVIS-BESSE NUCLEAR POWER STATION. Construction Permit No. CPPR-80, Amendment 1. (Directorate of Licensing (AEC), Washington, D. C.). 26 Sep 1972. 4p. Dep. NTIS.

58161 (DOCKET-50382-38) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Application for Licenses, Amendment 24. (Louisiana Power and Light Co., New Orleans). 22 Sep 1972. 5p. Dep. NTIS.

Financial data on the owners of the Waterford Power Reactor Unit 3 are presented. (D.C.C.)

58162 (DOCKET-50400-25) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. License Application, Amendment 16. (Carolina Power and Light Co., Raleigh, N. C.). 15 Sep 1972. 4p. (DOCKET-50401-25; DOCKET-50402-25; DOCKET-50403-25). Dep. NTIS.

Cost data are presented for the Shearon Harris Power Reactor, Units 1, 2, 3, and 4 nuclear steam supply systems, related equipment, and fuel procurement services. (H.D.R.)

58163 (DOCKET-50409-15) LA CROSSE BOILING WATER REACTOR. Order Extending the Expiration Date of Provisional Operating Authorization DPRA-6 to August 31, 1973. (Directorate of Licensing (AEC), Washington, D. C.). 31 Aug 1972. 2p. Dep. NTIS.

58164 (DOCKET-50409-16) LA CROSSE BOILING WATER REACTOR. Partial Reload of LACBWR Fuel to Reduce Iodine Releases. (Dairyland Power Cooperative, La Crosse, Wis.). 22 Sep 1972. 21p. (DPC-851-46). Dep. NTIS.

58165 (INIS-mf-189) OPTIMISATION TECHNIQUES IN POWER SYSTEM PLANNING FOR THE NORTHERN ELECTRICITY REGION. AEC Monograph No. 2. Chakravarti, M. N.; Narashimhan, R.; Seshagiri, N.; Shiralkar, S. S. (Atomic Energy Commission, Bombay (India)). 1971. 63p. INIS.

A general optimization model for the mix of plants developed to suit the power planning requirements of India during the fourth five-year plan of the northern regional grid interconnecting different states is presented. Construction of the model is based on the definition of a cost function to be minimized. A mathematical formulation suitable for the application of optimization techniques is given. Three computer studies have been made successively to obtain an optimum mix of thermal, hydel, and nuclear plants. Six alternative schemes which may be assumed to materialize by 1978-

79 are considered. Among these, the scheme of putting up two nuclear stations of 4000 MW, one each in Punjab/Haryana and Western U. P., in addition to thermal and hydel plants appears to be the most economical, giving the lowest system cost.

58166 WATER OR GAS COOLED REACTORS FOR THE UK? Lewins, J. (University Coll., London). J. Inst. Nucl. Eng.; 13: No. 3, 77-8(1972).

The Vinter Committee will advise on the next series of nuclear reactors to be ordered for the UK. The question is whether Advanced Gas Cooled Reactors (AGRs) should continue to be ordered, or should a change be made to the U.S.-developed Light Water Reactors (LWRs). The AGRs have a high capital cost and there are delays in construction and commission but they have higher thermal efficiency and can utilize standard generating sets. The LWRs have a lower capital cost but are also experiencing construction difficulties and they have a higher cooling water requirement. The UK has expertise in AGRs and may recoup money on repeat design orders, whereas it has no experts on LWRs and has insufficient facilities for manufacture. (UK)

Safety and Siting

Refer also to abstracts 56092, 56408, 56409, and 58079.

58167 (ANCR–1065) SEMISCALE PROJECT TEST DATA REPORT: TEST 851. Curry, T. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). Jul 1972. Contract AT(10-1)-1375. 94p. Dep. NTIS.

The test data from a decompression experiment (Test 851) performed in the Semiscale Project as part of the Water Reactor Safety Program of the U. S. Atomic Energy Commission are presented. The data are intended to provide a basis for assessing analytical codes used to predict the response of pressurized water reactors to decompression and ECC injection during a hypothetical major loss-of-coolant accident (LOCA). Semiscale Test 851 was initiated by a hot leg (outlet piping) break of a system that included both a single operating loop and a vessel with an electrically heated rod bundle. The objective of this test was to obtain experimental information relative to the effects of coolant injection on the availability of cooling fluid to a heater rod bundle and on primary system decompression phenomena. The substantial differences between the semiscale test system and a large nuclear reactor, and the differences in the related phenomenologies during a postulated LOCA, make invalid extrapolation of the results of this test to a reactor. The test data are intended only for purposes of development and evaluation of analysis methods. The system hardware and test conditions are described, the data acquisition, processing, and normalization methods are discussed, and data plots for pressures, temperatures, densities, flow rates, and power for Test 851 are presented. 9 references. (auth)

58168 (BAW–10048(Suppl.1)(Rev.1)) MULTINODE ANALYSIS OF B AND W's 145-FUEL-ASSEMBLY NUCLEAR PLANTS DURING LOSS-OF-COOLANT ACCIDENT. Supplement 1, Revision 1. Parks, C. E.; Allen, R. J.; Schermer, W. J. (Babcock and Wilcox Co., Lynchburg, VA. (USA). Nuclear Power Generation Div.). Sep 1972. 19p.

An analysis is made of the double-ended break of the pipe that connects a core flood tank to the reactor vessel at a point between the reactor vessel core flooding line nozzle and the first upstream check valve in the flooding line. The analysis utilized the evaluation model described in BAW-10048, Multinode Analysis of B&W's 145-Fuel Assembly Nuclear Plants During Loss-of-Coolant Accident. (4 references) (auth)

58169 (DOCKET-1151–59) ELK RIVER REACTOR. Operating Authorization DPRA-3, Amendment 2. (Directorate of Licensing (AEC), Washington, D. C.). 28 Sep 1972. 3p. Dep. NTIS.

58170 (DOCKET-50003–126) INDIAN POINT STATION, UNIT 1. Report of Radioactive Effluent, January–June 1972. (Consolidated Edison Co. of New York, Inc., New York). 31 Aug 1972. 5p. Dep. NTIS.

58171 (DOCKET-50003–127) INDIAN POINT STATION, UNIT 1. Reevaluation of the Stress Analysis for All Safety and Relief Valve Installations. (Consolidated Edison Co. of New York, Inc., New York). 14 Sep 1972. 4p. Dep. NTIS.

58172 (DOCKET-50003–128) INDIAN POINT STATION, UNIT 1. Additional Information on Modified Design of 4" Thermal Sleeve. (Consolidated Edison Co. of New York, Inc., New York). 26 Sep 1972. 205p. Dep. NTIS.

When the check valve isolating the No. 12 Steam Generator at Indian Point Plant No. 1 is closed, makeup water backflows through the primary line into the reactor vessel. At the request of Consolidated Edison, the Franklin Institute Research Laboratories investigated the structural consequences. Thermal and structural analyses and critical point fatigue evaluations were made for components washed by the backflow. Analyses show that for the conditions considered, all components are in compliance with the ASME Boiler and Pressure Vessel Code, Section III, 1971 requirements, and are capable of sustaining a 30 year fatigue life. (auth)

58173 (DOCKET-50003–129) INDIAN POINT STATION, UNIT 1. Petition to Convert Provisional Operating License to Full-Term Operating License. (Consolidated Edison Co. of New York, Inc., New York). Apr 1972. 44p. Dep. NTIS.

58174 (DOCKET-50003–130) INDIAN POINT STATION, UNIT 1. Pressurizer Safety Valves Reanalyzed. (Consolidated Edison Co. of New York, Inc., New York). 3 Oct 1972. 3p. Dep. NTIS.

58175 (DOCKET-50003–131) INDIAN POINT STATION, UNIT 1. Technical Specifications, Additional Information for DOCKET-50003–111. (Consolidated Edison Co. of New York, Inc., New York). 2 Oct 1972. 4p. Dep. NTIS.

Drawings are presented of the stack for the Indian Point Power Reactor, Unit 1. The sketches depict the original configuration of the stack and a proposed modification for the removal of the top 80 feet. (H.D.R.)

58176 (DOCKET-50029–203) YANKEE NUCLEAR POWER STATION. New In-Core Instrumentation Ordered. (Yankee Atomic Electric Co., Westboro, Mass.). 18 Sep 1972. 2p. Dep. NTIS.

58177 (DOCKET-50133–95) HUMBOLDT BAY POWER PLANT, UNIT 3. Geology of the Southern Humboldt Bay Area and the Humboldt Bay Power Plant Site. (California Univ., Berkeley. Earth Sciences Associates, Palo Alto, Calif. (USA)). Aug 1972. 308p. Dep. NTIS.

Includes 17 Drawings.

For Pacific Gas and Electric Co., San Francisco, Calif.

58178 (DOCKET-50133–96) HUMBOLDT BAY POWER PLANT, UNIT 3. Inspection and Modification of Suppression Chamber Baffles. (Pacific Gas and Electric Co., San Francisco, Calif.). 2 Oct 1972. 4p. Dep. NTIS.

58179 (DOCKET-50133–97) HUMBOLDT BAY POWER PLANT, UNIT 3. Review in Light of Recent Flood Incident at Quad-Cities No. 1. (Pacific Gas and Electric Co., San Francisco, Calif.). 5 Oct 1972. 2p. Dep. NTIS.

58180 (DOCKET-50155–126) BIG ROCK POINT NUCLEAR PLANT. Exciter Armature on Diesel Generator Failed. (Consumers Power Co., Jackson, Mich.). 18 Sep 1972. 3p. Dep. NTIS.

58181 (DOCKET-50155–127) BIG ROCK POINT NUCLEAR PLANT. Big Rock Point Loss-of-Coolant Analysis with Automatic Depressurization and NFS Demonstration Fuel. (Consumers Power Co., Jackson, Mich.). Jul 1972. 28p. Dep. NTIS.

The consequences of a loss-of-coolant accident in the Big Rock Point Reactor plant were calculated using the Atomic Energy Commission's Interim Acceptance Criteria. The analysis assumed the existence of an automatic depressurization system, (ADS) capable of relieving 433 lb/second of saturated steam at 1350 psia. The analysis was conducted for the Nuclear Fuel Services (NFS) demonstration fuel (design basis accident peak cladding temperature 2129°F) and for the current fuel (design basis accident peak cladding temperature 2740°F). Lower temperatures were calculated for smaller breaks. Therefore, installation of the specified ADS and use of NFS demonstration fuel will make Big Rock Point acceptable under the Interim Acceptance Criteria. (auth)

58182 (DOCKET-50206–168) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Unit Returned to Operation at 450 MW Gross on September 13, 1972. (Southern California Edison Co., Rosemead, Calif.). 15 Sep 1972. 1p. Dep. NTIS.

58183 (DOCKET-50206–170) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Analysis of Second Surveillance Material Capsule. (Southern California Edison Co., Rosemead, Calif.). Jul 1972. 25p. Dep. NTIS.

The second irradiation surveillance capsule was removed from the San Onofre Power Reactor, Unit 1 vessel following 2.9 full-power years operation. The results of the analysis showed that the capsule received a fast fluence of 2.36×10^{19} neutrons/cm^2

which increased the nil ductility transition temperature by 130°F. (H.D.R.)

58184 (DOCKET-50206–171) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Main Feedwater Pump Incident. (Southern California Edison Co., Rosemead, Calif.). 29 Sep 1972. 2p. Dep. NTIS.

58185 (DOCKET-50213–160) HADDAM NECK PLANT, UNIT 1. Technical Specifications, Proposed Change No. 20. (Connecticut Yankee Atomic Power Co., Hartford). 21 Sep 1972. 11p. Dep. NTIS.

Revised technical specifications are presented concerning the use of respiratory protective equipment by personnel. (D.C.C.)

58186 (DOCKET-50219–214) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Emergency Core Cooling System Suction Header. (Jersey Central Power and Light Co., Morristown, N. J.). 22 Aug 1972. 6p. Dep. NTIS.

58187 (DOCKET-50219–217) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Amendment 68, Supplement 1. (Jersey Central Power and Light Co., Morristown, N. J.). 6 Oct 1972. 76p. Dep. NTIS.

Additional information is presented concerning the fuel cask drop protection system. (D.C.C.)

58188 (DOCKET-50220–107) NINE MILE POINT NUCLEAR STATION, UNIT 1. Primary and Secondary Containment Leak Test. (Niagara Mohawk Power Corp., Syracuse, N. Y.). May 1972. 17p. Dep. NTIS.

58189 (DOCKET-50220–108) NINE MILE POINT NUCLEAR STATION, UNIT 1. Emergency Core Cooling System Suction Header. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 30 Jun 1972. 1p. Dep. NTIS.

58190 (DOCKET-50220–109) NINE MILE POINT NUCLEAR STATION, UNIT 1. There is no Flooding Potential for Existing Engineered Safety Systems. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 29 Sep 1972. 4p. Dep. NTIS.

58191 (DOCKET-50220–110) NINE MILE POINT NUCLEAR STATION, UNIT 1. Cask Drop Protection System. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 29 Sep 1972. 35p. Dep. NTIS.

The cask drop protection system for the Nine Mile Point Power Reactor, Unit 1 is described. The system consists of a circular base plate attached to the bottom of the spent fuel shipping cask and a combination guide structure-dashpot assembly which is installed in a corner of the spent fuel pool. The structural design is based on the worst case loadings associated with a wide range of postulated cask drop accidents. (H.D.R.)

58192 (DOCKET-50231–124) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Technical Specifications, Proposed Changes. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). 14 Sep 1972. 2p. Dep. NTIS.

Revised technical specifications for SEFOR are proposed to reflect the decommissioned status of the facility. (H.D.R.)

58193 (DOCKET-50231–125) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Technical Specifications, Change 14. (Directorate of Licensing (AEC), Washington, D. C.). 3 Oct 1972. 2p. Dep. NTIS.

58194 (DOCKET-50237–262) DRESDEN NUCLEAR POWER STATION, UNIT 2. Repair of Main Steam Lines Completed. (Commonwealth Edison Co., Chicago, Ill.). 19 Sep 1972. 1p. Dep. NTIS.

58195 (DOCKET-50237–263) DRESDEN NUCLEAR POWER STATION, UNIT 2. High Pressure Scram Switch Setpoints Drifted. (Commonwealth Edison Co., Chicago, Ill.). 18 Sep 1972. 1p. Dep. NTIS.

58196 (DOCKET-50237–264) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Electrohydraulic Control Oil Low Pressure Scram Switches Setpoints Drifted Beyond Limits. (Commonwealth Edison Co., Chicago, Ill.). 18 Sep 1972. 2p. (DOCKET-50249–159). Dep. NTIS.

58197 (DOCKET-50237–265) DRESDEN NUCLEAR POWER STATION, UNIT 2. Setpoint of Two Reactor Low Pressure Permissive Switches Drifted. (Commonwealth Edison Co., Morris, Ill. (USA)). 21 Sep 1972. 3p. Dep. NTIS.

58198 (DOCKET-50237–266) DRESDEN NUCLEAR POWER STATION, UNIT 2. 2/3 Diesel Auto-Started, Tripped, and Failed to Restart. (Commonwealth Edison Co., Chicago, Ill.). 3 Oct 1972. 2p. Dep. NTIS.

58199 (DOCKET-50244–119) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Potential Exposure to Workman of Higher than Permissible Concentrations, Supplemental Information to DOCKET-50244–103. (Rochester Gas and Electric Corp., N. Y.). 20 Sep 1972. 1p. Dep. NTIS.

58200 (DOCKET-50244–120) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Flooding of Critical Equipment. (Rochester Gas and Electric Corp., N. Y.). 3 Oct 1972. 1p. Dep. NTIS.

58201 (DOCKET-50245–163) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Response to 72-1, Failed Hangers for Emergency Core Cooling System Suction Header. (Millstone Point Co., Hartford, Conn.). 7 Jul 1972. 2p. Dep. NTIS.

58202 (DOCKET-50245–165) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Flooding of Critical Equipment. (Millstone Point Co., Hartford, Conn.). 2 Oct 1972. 2p. Dep. NTIS.

58203 (DOCKET-50245–167) MILLSTONE POINT NUCLEAR POWER STATION, UNITS 1 AND 2. Environmental Report, Amendment 1 and Addendum 2. (Millstone Point Co., Hartford, Conn.). 11 Oct 1972. 398p. (DOCKET-50336–43). Dep. NTIS.

58204 (DOCKET-50247–82) INDIAN POINT NUCLEAR GENERATING UNIT 2. Final Environmental Statement, Volume 1. (Directorate of Licensing (AEC), Washington, D. C.). Sep 1972. 607p. Dep. NTIS.

The environmental effects of construction and operation of the Indian Point Power Reactor, Unit 2 are examined. The descriptions include (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (H.D.R.)

58205 (DOCKET-50247–83) INDIAN POINT NUCLEAR GENERATING UNIT 2. Final Environmental Statement, Volume 2. (Directorate of Licensing (AEC), Washington, D. C.). Sep 1972. 291p. Dep. NTIS.

58206 (DOCKET-50247–84) INDIAN POINT NUCLEAR GENERATING UNIT 2. Order Extending Facility Operating License Expiration Date. (Directorate of Licensing (AEC), Washington, D. C.). 13 Oct 1972. 2p. Dep. NTIS.

58207 (DOCKET-50249–163) DRESDEN NUCLEAR POWER STATION, UNIT 3. Set Points of High Condensate Flow Switches Found to Have Drifted. (Commonwealth Edison Co., Chicago Ill.). 29 Sep 1972. 2p. Dep. NTIS.

58208 (DOCKET-50250–95) TURKEY POINT PLANT, UNITS 3 AND 4. Technical Specifications, Proposed Change. (Florida Power and Light Co.). 20 Sep 1972. 9p. (DOCKET-50251–78). Dep. NTIS.

Revised technical specifications for Turkey Point Power Reactor, Units 3 and 4 are proposed to change the low setting for the reactor coolant pump motor frequency trip, change the horizontal tendon numbers for surveillance, and correct the errors in the original wording of the specifications. (H.D.R.)

58209 (DOCKET-50254–122) QUAD-CITIES STATION, UNIT 1. Failure of Three RCIC Valves to Operate Correctly. (Commonwealth Edison Co., Cordova, Ill.). 11 Sep 1972. 2p. Dep. NTIS.

58210 (DOCKET-50254–124) QUAD-CITIES STATION, UNITS 1 AND 2. Status of the Torus Vacuum Breakers. (Commonwealth Edison Co., Chicago, Ill.). 19 Sep 1972. 1p. (DOCKET-50265–118). Dep. NTIS.

58211 (DOCKET-50254–127) QUAD-CITIES STATION, UNITS 1 AND 2. Determination of Thermal Effects in the Mississippi River. (Commonwealth Edison Co., Chicago, Ill.). 3 Oct 1972. 776p. (DOCKET-50265–120). Dep. NTIS.

58212 (DOCKET-50254–129) QUAD-CITIES STATION, UNITS 1 AND 2. Additional Information Concerning the Cask Drop Accidents. (Commonwealth Edison Co., Chicago, Ill.). 3 Oct 1972. 9p. (DOCKET-50265–121). Dep. NTIS.

58213 (DOCKET-50255-101) PALISADES PLANT. Review of Main Steam Safety Valves. (Consumers Power Co., Jackson, Mich.). 15 Sep 1972. 3p. Dep. NTIS.

58214 (DOCKET-50255-102) PALISADES PLANT. During Quarterly Testing, One Containment Sump Isolation Valve Failed to Respond to an Open Signal. (Consumers Power Co., Jackson, Mich.). 21 Sep 1972. 2p. Dep. NTIS.

58215 (DOCKET-50259-64) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Notice of Consideration of Issuance of Facility Operating Licenses and Notice of Opportunity for Hearing. (Directorate of Licensing (AEC), Washington, D. C.). 20 Sep 1972. 5p. (DOCKET-50260-60; DOCKET-50296-57). Dep. NTIS.

58216 (DOCKET-50259-65) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Order Extending Provisional Construction Completion Dates. (Directorate of Licensing (AEC), Washington, D. C.). 26 Sep 1972. 4p. (DOCKET-50260-61; DOCKET-50296-58). Dep. NTIS.

58217 (DOCKET-50259-67) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 4 Oct 1972. 158p. (DOCKET-50260-63; DOCKET-50296-60). Dep. NTIS.

58218 (DOCKET-50261-110) H. B. ROBINSON UNIT 2. Technical Specifications, Revision of Request for Change. (Carolina Power and Light Co., Raleigh, N. C.). 20 Sep 1972. 3p. Dep. NTIS.

Revised technical specifications are presented concerning the management organization chart. (D.C.C.)

58219 (DOCKET-50261-112) H. B. ROBINSON UNIT 2. Waste Evaporator Modifications. (Carolina Power and Light Co., Raleigh, N. C.). 22 Sep 1972. 20p. Dep. NTIS.

58220 (DOCKET-50261-115) H. B. ROBINSON UNIT 2. Boron Injection Tank Dilution. (Carolina Power and Light Co., Raleigh, N. C.). 28 Sep 1972. 5p. Dep. NTIS.

58221 (DOCKET-50263-151) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Technical Specifications, Supplement 1 to Change Request 3. (Northern States Power Co., Minneapolis, Minn.). 22 Sep 1972. 13p. Dep. NTIS.

Revised technical specifications are presented concerning the control rod worth minimizer, core reactivity margin, suppression chamber inspection, gaseous radioactive effluents, and liquid radioactive effluents. (D.C.C.)

58222 (DOCKET-50263-152) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Potential for Flooding Evaluated. (Northern States Power Co., Minneapolis, Minn.). 28 Sep 1972. 3p. Dep. NTIS.

58223 (DOCKET-50263-153) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Failure of PEECO Flow Switch Actuator Paddles. (Northern States Power Co., Minneapolis, Minn.). 26 Sep 1972. 3p. Dep. NTIS.

58224 (DOCKET-50266-81) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Steps Taken to Correct the Item of Apparent Noncompliance Brought to Attention in Letter Dated August 9, 1972. (Wisconsin Electric Power Co., Milwaukee). 28 Aug 1972. 7p. (DOCKET-50301-72). Dep. NTIS.

Actions taken to survey the gaseous tritium releases to the atmosphere from the steam generator blowdown tank vent and the turbine building ventilation system roof exhausters are described. (H.D.R.)

58225 (DOCKET-50266-82) POINT BEACH NUCLEAR PLANT, UNIT 1. Failure to Conduct Periodic Test of Nuclear Instrument Intermediate Ranges Prior to Reactor Startup. (Wisconsin Electric Power Co., Milwaukee). 19 Sep 1972. 2p. Dep. NTIS.

58226 (DOCKET-50266-83) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Inadvertent Release of Radioactivity. (Wisconsin Electric Power Co., Milwaukee). 30 Sep 1972. 3p. (DOCKET-50301-74). Dep. NTIS.

58227 (DOCKET-50267-46) FORT ST. VRAIN NUCLEAR GENERATING STATION. Control Orificing Assemblies. (Public Service Co. of Colorado, Denver). 11 Aug 1972. 4p. Dep. NTIS.

Seven spare control and orificing assemblies were inspected and found to be corroded. The causes of the assembly corrosion are evaluated and corrective action taken to prevent a recurrence is described. (H.D.R.)

58228 (DOCKET-50269-65) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 35. (Duke Power Co., Charlotte, N. C.). 15 Sep 1972. 97p. (DOCKET-50270-52; DOCKET-50287-47). Dep. NTIS.

The final safety analysis report for the Oconee Power Reactor, Units 1, 2, and 3 is amended by the submission of revised information and requested financial data. (H.D.R.)

58229 (DOCKET-50271-102) VERMONT YANKEE NUCLEAR POWER STATION. Emergency Core Cooling System Suction Headers. (Vermont Yankee Nuclear Power Corp., Rutland). 30 Jun 1972. 1p. Dep. NTIS.

58230 (DOCKET-50271-105) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence AO-72-05. (Vermont Yankee Nuclear Power Corp., Rutland). 27 Sep 1972. 3p. Dep. NTIS.

Two incidents of abnormal operation at the Vermont Yankee Power Reactor are reported. The bellows of the main steam relief valve located on main steam line D failed on September 19, 1972. On September 21, the supply valve to the off-gas monitoring system was discovered to be closed with the reactor operating at 15% power. Plant operating procedures were changed to prevent a recurrence of the latter incident. (H.D.R.)

58231 (DOCKET-50272-37) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Apparent Nonconformance Embedded Containment Liner Anchors. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 31 May 1972. 2p. (DOCKET-50311-37). Dep. NTIS.

58232 (DOCKET-50272-38) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Reply to Inquiry on Flood Damage June 18-24, 1972. (Public Service Electric and Gas Co., Newark, N. J.). 29 Jun 1972. 2p. (DOCKET-50311-38; DOCKET-50354-30; DOCKET-50355-29). Dep. NTIS.

58233 (DOCKET-50272-39) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Action Taken to Correct Items of Noncompliance and Nonconformance Brought to Attention Following Inspection of June 20-22, 1972. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 11 Sep 1972. 8p. (DOCKET-50311-39). Dep. NTIS.

58234 (DOCKET-50275-26) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 1. Steps Taken to Correct the Item Brought to Attention in Letter Dated August 23, 1972. (Pacific Gas and Electric Co., San Francisco, Calif.). 12 Sep 1972. 4p. Dep. NTIS.

The placement of four vertical wide-flange structural steel columns in the support structure for the No. 4 steam generator of Diablo Canyon Power Reactor, Unit 1 is reported. These columns were identified on the structure erection drawing as legs for one of the other support structures. Since the legs for all the support structures are identical, they were left in place and the discrepancy was documented to identify the columns as actually installed. (H.D.R.)

58235 (DOCKET-50277-58) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Notice of Consideration of Issuance of Facility Operating Licenses and Notice of Opportunity for Hearing. (Directorate of Licensing (AEC), Washington, D. C.). 27 Sep 1972. 7p. (DOCKET-50278-59). Dep. NTIS.

58236 (DOCKET-50277-59) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Interim Report of Flood Damage to Equipment Resulting from Tropical Disturbance "Agnes." (Philadelphia Electric Co., Pa.). 11 Jul 1972. 2p. (DOCKET-50278-60). Dep. NTIS.

58237 (DOCKET-50277-61) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Applicant's Environmental Report, Operating License Stage, Supplement 6. (Philadelphia Electric Co., Pa.). 29 Sep 1972. 9p. (DOCKET-50278-62). Dep. NTIS.

58238 (DOCKET-50277-62) PEACH BOTTOM ATOMIC POWER STATION, UNIT 3. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 3 Oct 1972. 163p. (DOCKET-50278-63). Dep. NTIS.

58239 (DOCKET-50277-64) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Order Extending Provisional Construction Permit Completion Date. (Directorate of Licensing (AEC), Washington, D. C.). 10 Oct 1972. 3p. Dep. NTIS.

58240 (DOCKET-50280-86) SURRY POWER STATION, UNIT 1. Technical Specifications, Change 2 Authorized. (Directorate of Licensing (AEC), Washington, D. C.). 28 Sep 1972. 6p. Dep. NTIS.

58241 (DOCKET-50282-75) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 23. (Northern States Power Co., Minneapolis, Minn.). 19 Sep 1972. 50p. (DOCKET-50306-71). Dep. NTIS.

The final safety analysis report for the Prairie Island Power Reactor, Units 1 and 2 is amended by the submission of revised and additional data. (H.D.R.)

58242 (DOCKET-50286-54) INDIAN POINT NUCLEAR GENERATING UNIT 3. Applicants Environmental Report, Supplement 2. (Consolidated Edison Co. of New York, Inc., New York). 11 Sep 1972. 285p. Dep. NTIS.

58243 (DOCKET-50289-70) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Reply to Inquiry Concerning the Flooding Conditions of June 27, 1972. (Metropolitan Edison Co., Reading, Pa.). 30 Jun 1972. 6p. (DOCKET-50320-31). Dep. NTIS.

58244 (DOCKET-50289-71) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Action Taken to Correct Items of Noncompliance Brought to Attention Following Inspection on May 31-June 1, 1972. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 22 Sep 1972. 9p. (DOCKET-50320-32). Dep. NTIS.

58245 (DOCKET-50289-72) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Final Safety Analysis Report, Amendment 31. (Metropolitan Edison Co., Reading, Pa.). 28 Sep 1972. 189p. Dep. NTIS.

The Technical Specifications for the Three Mile Island Power Reactor, Unit 1 are completely revised. The completed power escalation testing program is presented. (H.D.R.)

58246 (DOCKET-50293-89) PILGRIM NUCLEAR POWER STATION. Unusual Occurrence. (Boston Edison Co., Mass.). 5 Sep 1972. 6p. Dep. NTIS.

The main steam line pipe hanger assemblies were damaged during startup testing of the Pilgrim Power Reactor. The probable cause of the damage and the corrective action taken are discussed. (H.D.R.)

58247 (DOCKET-50293-91) PILGRIM NUCLEAR POWER STATION. Abnormal Occurrence AO-72-8. (Boston Edison Co., Mass.). 19 Sep 1972. 1p. Dep. NTIS.

During a surveillance test of the Pilgrim Power Reactor high pressure coolant injection system, electrical jumpers were installed on the HPCI pump suction switches to prevent their operation by false signals. The jumpers were left in place during subsequent reactor operation at 17% power. Actions taken to correct the situation and prevent a recurrence are described. (H.D.R.)

58248 (DOCKET-50293-93) PILGRIM NUCLEAR POWER STATION. Station has No Emergency Core Cooling System Suction Header. (Boston Edison Co., Mass.). 30 Jun 1972. 1p. Dep. NTIS.

58249 (DOCKET-50295-63) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Wisconsin Public Service Commission Objects to Emergency Plan Because it Does Not Include Liaison With Wisconsin. (Wisconsin Public Service Commission, Madison (USA)). 26 Sep 1972. 3p. (DOCKET-50304-63). Dep. NTIS.

58250 (DOCKET-50295-65) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Notice of Hearing on a Facility Operating License. (Commonwealth Edison Co., Chicago, Ill.). 29 Sep 1972. 11p. (DOCKET-50304-65). Dep. NTIS.

58251 (DOCKET-50298-51) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 14. (Nebraska Public Power District, Columbus). 8 Sep 1972. 259p. Dep. NTIS.

The final safety analysis report for the Cooper Power Reactor is amended by the submission of requested additional information. (H.D.R.)

58252 (DOCKET-50298-53) COOPER NUCLEAR STATION. Notice of Consideration of Issuance of Facility License and Notice of Opportunity for Hearing. (Directorate of Licensing (AEC), Washington, D. C.). 11 Oct 1972. 8p. Dep. NTIS.

58253 (DOCKET-50305-50) KEWAUNEE NUCLEAR POWER PLANT. Steps Taken to Correct Items of Apparent Noncompliance Brought to Attention in Letter Dated August 8, 1972. (Wisconsin Public Service Corp., Green Bay). 5 Sep 1972. 7p. Dep. NTIS.

Actions taken to correct deficiencies in the quality assurance program and in the procedures for cleaning and flushing the nuclear steam supply system are described. (H.D.R.)

58254 (DOCKET-50305-52) KEWAUNEE NUCLEAR POWER PLANT. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 22 Sep 1972. 173p. Dep. NTIS.

58255 (DOCKET-50312-53) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Final Safety Analysis Report, Amendment 16. (Sacramento Municipal Utility District, Calif.). 18 Sep 1972. 43p. Dep. NTIS.

The final safety analysis report for the Rancho Seco Power Reactor, Unit 1 is amended by the submission of responses to requests for additional information. (H.D.R.)

58256 (DOCKET-50312-54) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Environmental Report, Additional Information. (Sacramento Municipal Utility District, Calif.). 28 Sep 1972. 3p. Dep. NTIS.

Requested data are presented concerning estimated costs for alternate secondary cooling systems. (D.C.C.)

58257 (DOCKET-50312-55) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Notice of Consideration of Issuance of Facility License and Notice of Opportunity for Hearing. (Directorate of Licensing (AEC), Washington, D. C.). 11 Oct 1972. 7p. Dep. NTIS.

58258 (DOCKET-50313-51) ARKANSAS NUCLEAR ONE, UNIT 1. Final Safety Analysis Report, Amendment 30. (Arkansas Power and Light Co., Little Rock). 15 Sep 1972. 41p. Dep. NTIS.

The final safety analysis report for the Arkansas Nuclear One Power Reactor, Unit 1 is amended by the submission of requested additional information. (H.D.R.)

58259 (DOCKET-50313-52) ARKANSAS NUCLEAR ONE, UNIT 1. Incorporation of B and W Topical Reports. (Arkansas Power and Light Co., Little Rock). 2 Oct 1972. 2p. Dep. NTIS.

58260 (DOCKET-50315-84) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Ice Condenser Being Redesigned. (American Electric Power Service Corp., New York). 11 Oct 1972. 4p. (DOCKET-50316-84). Dep. NTIS.

58261 (DOCKET-50315-85) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 30. (Indiana and Michigan Power Co., New York). 17 Oct 1972. 236p. (DOCKET-50316-85). Dep. NTIS.

Revised and requested data are presented concerning the emergency core cooling system performance; safety analysis of coolant loss accidents; personnel qualifications; quality assurance program; diesel generators; instrumentation; engineered safeguards; structures; and cooling system. (D.C.C.)

58262 (DOCKET-50317-59) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 26. (Baltimore Gas and Electric Co., Md.). 18 Sep 1972. 78p. (DOCKET-50318-56). Dep. NTIS.

The final safety analysis report for the Calvert Cliffs Power Reactor, Units 1 and 2 is amended by the submission of revised information. (H.D.R.)

58263 (DOCKET-50317-60) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 25 Sep 1972. 112p. (DOCKET-50318-57). Dep. NTIS.

58264 (DOCKET-50324-44) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. License Application, General Information. (Carolina Power and Light Co., Raleigh, N. C.). 30 May 1972. 11p. (DOCKET-50325-45). Dep. NTIS.

58265 (DOCKET-50324-46) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Volume 1. (Carolina Power and Light Co., Raleigh, N. C.). Apr 1972. 430p. (DOCKET-50325-47). Dep. NTIS.

Information on the Brunswick Power Reactor Units 1 and 2 is presented concerning the reactor site and the reactor core. (D.C.C.)

58266 (DOCKET-50324-47) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Volume 2. (Carolina Power and Light Co., Raleigh, N. C.). Apr 1972. 373p. (DOCKET-50325-48). Dep. NTIS.

Information on the Brunswick Power Reactor Units 1 and 2 is presented under the following broad topics: cooling system; containment system; and emergency core cooling system. (D.C.C.)

58267 (DOCKET-50324-48) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Volume 3. (Carolina Power and Light Co., Raleigh, N. C.). Apr 1972. 453p. (DOCKET-50325-49). Dep. NTIS.

Information on the Brunswick Power Reactor Units 1 and 2 is presented concerning instrumentation and control systems. (D.C.C.)

58268 (DOCKET-50324-49) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Volume 4. (Carolina Power and Light Co., Raleigh, N. C.). Apr 1972. 243p. (DOCKET-50325-50). Dep. NTIS.

Information on the Brunswick Power Reactor Units 1 and 2 is presented concerning electrical systems and radioactive waste processing systems. (D.C.C.)

58269 (DOCKET-50324-50) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Volume 5. (Carolina Power and Light Co., Raleigh, N. C.). Apr 1972. 296p. (DOCKET-50325-51). Dep. NTIS.

Information on the Brunswick Power Reactor Units 1 and 2 is presented under the following broad topics: auxiliary systems; power conversion systems; mechanical structures; and shielding. (D.C.C.)

58270 (DOCKET-50324-51) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Volume 6. (Carolina Power and Light Co., Raleigh, N. C.). Apr 1972. 431p. (DOCKET-50325-52). Dep. NTIS.

Information on the Brunswick Power Reactor Units 1 and 2 is presented concerning conduct of operations and plant safety analysis. (D.C.C.)

58271 (DOCKET-50324-52) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Volume 7. (Carolina Power and Light Co., Raleigh, N. C.). Apr 1972. 424p. (DOCKET-50325-53). Dep. NTIS.

Information on the Brunswick Power Reactor Units 1 and 2 is presented concerning pressure boundary integrity criteria, interaction between units, structural design and loading criteria, quality assurance program, and atmospheric release limit calculations. (D.C.C.)

58272 (DOCKET-50331-53) DUANE ARNOLD ENERGY CENTER. Additional Comments Relative to the Item of Apparent Noncompliance Brought to Attention in Letter of June 1, 1972. (Iowa Electric Light and Power Co., Cedar Rapids). 1 Sep 1972. 9p. Dep. NTIS.

Measures are discussed for on-site repair and quality assurance inspection of defective control room panels. (H.D.R.)

58273 (DOCKET-50331-54) DUANE ARNOLD ENERGY CENTER. Final Safety Analysis Report, Amendment 4. (Iowa Electric Light and Power Co., Cedar Rapids). Sep 1972. 349p. Dep. NTIS.

The final safety analysis report for the Duane Arnold Power Reactor is amended by the submission of responses to AEC safety guides, responses to specific questions, a report on mechanical property surveillance in BWR vessels, and additional information concerning on-site meteorology. (H.D.R.)

58274 (DOCKET-50331-55) DUANE ARNOLD ENERGY CENTER. Steps Taken to Correct the Item of Apparent Noncompliance and Nonconformance Brought to Attention in Letter of August 17, 1972. (Iowa Electric Light and Power Co., Cedar Rapids). 20 Sep 1972. 6p. Dep. NTIS.

Additional information is presented concerning the improper use of carbon steel rod in stainless steel weld A-9. (D.C.C.)

58275 (DOCKET-50331-56) DUANE ARNOLD ENERGY CENTER. Final Safety Analysis Report, Amendment 5. (Iowa Electric Light and Power Co., Cedar Rapids). 29 Sep 1972. 165p. Dep. NTIS.

The final safety analysis report for the Duane Arnold Power Reactor is amended by the submission of revised and requested additional information. (H.D.R.)

58276 (DOCKET-50333-54) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment 11. (Power Authority of the State of New York. Niagara Mohawk Power Corp., Syracuse, N. Y.). 22 Sep 1972. 256p. Dep. NTIS.

The final safety analysis report for the James A. Fitzpatrick Power Reactor is amended by the submission of revised and additional information. A report on the site emergency plan and procedures is also presented. (H.D.R.)

58277 (DOCKET-50333-58) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Containment Atmosphere Dilution. (Power Authority of the State of New York). 2 Oct 1972. 14p. Dep. NTIS.

58278 (DOCKET-50334-33) BEAVER VALLEY POWER STATION, UNIT 1. Environmental Report, Amendment 2. (Duquesne Light Co., Pittsburgh, Pa.). 13 Sep 1972. 196p. Dep. NTIS.

58279 (DOCKET-50335-34) HUTCHINSON ISLAND PLANT, UNIT 1. Welding Procedures, WP-43 and WP-71. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 14 Sep 1972. 18p. Dep. NTIS.

58280 (DOCKET-50335-35) ST. LUCIE PLANT, UNIT 1. Steps Taken to Correct the Items of Apparent Noncompliance Brought to Attention in Letter Dated August 14, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 3 Oct 1972. 6p. Dep. NTIS.

58281 (DOCKET-50336-42) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 2. Construction Permit CPPR-76, Amendment 2. (Directorate of Licensing (AEC), Washington, D. C.). 26 Sep 1972. 5p. Dep. NTIS.

58282 (DOCKET-50336-44) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 2. Combined Notice of Receipt of Application for Operating License; Notice of Hearing Pursuant to 10 CFR Part 50, Appendix D, Section B; Notice of Consideration of Issuance of Facility Operating License; and Opportunity for Hearing. (Directorate of Licensing (AEC), Washington, D. C.). 11 Oct 1972. 10p. Dep. NTIS.

58283 (DOCKET-50341-46) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Construction Permit No. CPPR-87 Issued. (Directorate of Licensing (AEC), Washington, D. C.). 26 Sep 1972. 5p. Dep. NTIS.

58284 (DOCKET-50348-44) JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 1. Additional Steps Taken to Correct the Item of Apparent Noncompliance Again Brought to Attention in Letter Dated August 3, 1972. (Alabama Power Co., Birmingham). 22 Aug 1972. 11p. Dep. NTIS.

Deficiencies in procedures for chemical etching of steam generator nozzle safe end interfaces are discussed. (H.D.R.)

58285 (DOCKET-50354-29) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Preliminary Emergency Plan. (Public Service Electric and Gas Co., Newark, N. J.). 15 Sep 1972. 43p. (DOCKET-50355-28). Dep. NTIS.

A preliminary plan for coping with emergencies at the Newbold Island Power Reactor, Units 1 and 2 is presented. The primary objective of the plan is protection of the health and safety of the general public and the plant personnel. The plan identifies protective action levels, defines the courses of action to be taken, and specifies the duties of station and support personnel in the event of emergency situations. (H.D.R.)

58286 (DOCKET-50363-38) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 22 Sep 1972. 117p. Dep. NTIS.

58287 (DOCKET-50363-39) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Safety Evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 2 Oct 1972. 49p. Dep. NTIS.

58288 (DOCKET-50368-33) ARKANSAS NUCLEAR ONE, UNIT 2. Environmental Report, Supplement 3. (Arkansas Power and Light Co., Little Rock). 25 Sep 1972. 54p. Dep. NTIS.

Additional data are presented concerning chemical, radioactive, and thermal discharges from the reactor. (D.C.C.)

58289 (DOCKET-50368-34) ARKANSAS NUCLEAR ONE, UNIT 2. Emergency Core Cooling System Improvement Report. (Arkansas Power and Light Co., Little Rock). 3 Oct 1972. 17p. Dep. NTIS.

58290 (DOCKET-50382-37) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 23. (Louisiana Power and Light Co., New Orleans). 15 Sep 1972. 54p. Dep. NTIS.

The preliminary safety analysis report for the Waterford Power Reactor, Unit 3 is amended by the submission of additional information. (H.D.R.)

58291 (DOCKET-50390–25) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 28 Aug 1972. 151p. (DOCKET-50391–25). Dep. NTIS.

58292 (DOCKET-50395–29) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 29 Aug 1972. 115p. Dep. NTIS.

58293 (DOCKET-50395–30) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Draft Environmental Statement. (South Carolina Electric and Gas Co., Columbia). Sep 1972. 222p. Dep. NTIS.

The environmental effects of construction and operation of the Virgil C. Summer Power Reactor, Unit 1 are examined. The descriptions include (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the cost-benefits analysis of the proposed plant operation. (H.D.R.)

58294 (DOCKET-50397–29) HANFORD NO. 2 NUCLEAR POWER PLANT. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 22 Sep 1972. 163p. Dep. NTIS.

58295 (DOCKET-50398–20) MENDOCINO POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 13. (Pacific Gas and Electric Co., San Francisco, Calif.). 28 Sep 1972. 77p. (DOCKET-50399–20). Dep. NTIS.

The preliminary safety analysis report for the Mendocino Power Reactor, Units 1 and 2 is amended by the submission of revised and requested additional information. (H.D.R.)

58296 (DOCKET-50398–21) MENDOCINO POWER PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 13-a. (Pacific Gas and Electric Co., San Francisco, Calif.). 3 Oct 1972. 2p. (DOCKET-50399–21). Dep. NTIS.

58297 (DOCKET-50400–24) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Preliminary Safety Analysis Report, Amendment 15. (Carolina Power and Light Co., Raleigh, N. C.). 11 Sep 1972. 157p. (DOCKET-50401–24; DOCKET-50402–24; DOCKET-50403–24). Dep. NTIS.

The preliminary safety analysis report for the Shearon Harris Power Reactor, Units 1, 2, 3, and 4 is amended by the submission of responses to specific questions. (H.D.R.)

58298 (DOCKET-50400–26) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Opinion of Department of Justice with Regard to No Need for Antitrust Hearing. (Department of Justice, Washington, D. C. Antitrust Div.). 18 Aug 1972. 14p. (DOCKET-50401–26; DOCKET-50402–26; DOCKET-50403–26). Dep. NTIS.

58299 (DOCKET-50409–12) LA CROSSE BOILING WATER REACTOR. Incident Report. (Dairyland Power Cooperative, La Crosse, Wis.). 29 Aug 1972. 4p. (DPC–72-8). Dep. NTIS.

The failure of the speed control system on two reactor feedwater pumps resulted in an unplanned reactor shutdown. Actions taken to correct the malfunction are described. (H.D.R.)

58300 (DOCKET-50409–14) LA CROSSE BOILING WATER REACTOR. Incident Reports, Reactor Scram and Loss of Plant Power; Stack Release of ^{131}I in Excess of Technical Specification Limits. (Dairyland Power Cooperative, La Crosse, Wis.). 13 Sep 1972. 6p. (DPC–72-9; DPC–72-10). Dep. NTIS.

58301 (GEAP–13259) BLOWDOWN HEAT TRANSFER PROGRAM. TASK B-1 BWR FUEL ROD SIMULATION USING SKIN HEATERS. Wing, K. D. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan 1972. Contract AT(04-3)-189. 43p. Dep. NTIS.

Includes excerpt from BNWL–CC–2345.

Analyses have shown that the surface conditions of a fuel pin can be simulated by a skin heated test rod. Comparative surface temperatures and heat fluxes during core heatup between a fuel pin and a test rod are presented for the Design Basis Accident of a 218-560 G.E. 1969 Product Line Standard Plant. Specific test rods analyzed were both a rod of the original Columbia Design which used Al_2O_3 for the heater element support material, as well as a rod made by G.E. which replaces the Al_2O_3, with a mixed ceramic material. (5 references) (auth)

58302 (IRS-T–18, pp 37-95) REPORT OF THE PROGRESS FOR THE OBJECTIVE SAFETY EVALUATION. Mieze, G. (Technischer Ueberwachungs-Verein e. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). 1970. (In German). INIS.

A review is presented of the state of development in the field of the reliability analysis, mainly of the Institute for Reactor Safety (IRS). The aim of IRS in this field is to find a method for the safety evaluation of reactors independent of the type of reactor: 1) Development of a standard procedure for systems and reliability analyses of reactors. 2) Development of generally applicable measures (reliability standards) for evaluation of the results of reliability analyses. 3) Establishment of a data collection which will be set up according to the ideas of all persons concerned and which should contain the failure data of components required for reliability analysis. As a simple example, the application of the methods presently used in systems and reliability analyses is demonstrated for a by-pass cooling circuit. (auth)

58303 (NP–19440) HUMAN CONSEQUENCES OF TECHNOLOGICAL CHANGE: NUCLEAR POWER AND PUBLIC SAFETY. Mayer, I. (Australian Atomic Energy Commission). 1972. 20p. Dep. NTIS (U. S. Sales Only).

Energy, information and ingenuity are considered to be the basic elements of technological change. The energy factor is discussed with particular reference to the possible rejection by sectors of the public, of the bases of the claim by regulatory authorities that licensed nuclear power plants are safe. (Australia)

58304 (ORNL-NSIC–55(Vol.2)) DESIGN DATA AND SAFETY FEATURES OF COMMERCIAL NUCLEAR POWER PLANTS. VOL. II. DOCKET NO. 50-296 THROUGH 50-395. Heddleson, Fred A. (comp.) (Oak Ridge National Lab., Tenn.). Jan 1972. Contract W-7405-eng-26. 282p. Dep. NTIS.

Design data, safety features, and site characteristics are summarized for forty-seven commercial nuclear power plants in the United States. Six pages of data are presented for each plant consisting of Thermal-Hydraulic and Nuclear Factors, Containment Features, Emergency Core Cooling Systems, Site Features, Circulating Water System Data, and Miscellaneous Factors. A small aerial perspective is also presented for each plant site. Plants covered in this volume are Browns Ferry, Docket Number 50-296, and all subsequent plants finishing with Virgil C. Summer, Docket Number 50-395. (auth)

58305 (ORNL-NSIC–91) SAFETY-RELATED OCCURRENCES IN NUCLEAR FACILITIES AS REPORTED IN 1970. Scott, R. L. (Oak Ridge National Lab., Tenn.). Dec 1971. Contract W-7405-eng-26. 143p. Dep. NTIS.

Failures, incidents, or unusual occurrences in nuclear facilities that were reported during 1970 in various types of documents received by the Nuclear Safety Information Center are abstracted. The documents in this bibliography were selected on the basis that they were related to safety, were significant to nuclear facility operations, and that they indicated a need for closer scrutiny in order to improve both the safety and operation of nuclear facilities. For convenience, the information has been organized according to the type of facility or operation involved, i.e., PWR, BWR, or Radiography, etc. In addition, the bibliography contains a keyword index which may be reviewed to identify those abstracts which discuss a specific facility, a specific piece of equipment, the type of failure involved, or the cause of the occurrence. An author index is also provided. (auth)

58306 (ORNL-NSIC–106) SAFETY-RELATED OCCURRENCES IN NUCLEAR FACILITIES AS REPORTED IN 1971. Scott, R. L.; Gallaher, R. B. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 177p. Dep. NTIS.

Failures, incidents, and unusual occurrences in nuclear facilities that were reported during 1971 in various types of documents received by the Nuclear Safety Information Center are abstracted. For convenience, the information has been organized according to the type of facility or operation involved, i.e., BWR, PWR, or Radiography, etc. In addition, a keyword index is provided and may be reviewed to identify those abstracts which discuss a specific facility, a specific piece of equipment, the type of failure involved, or the cause of the occurrence. An author index is also provided. A cursory review of all the abstracts in this bibliography was made and where applicable tables were prepared to summarize the information. A discussion of the tables and the content of the abstracts is presented for each section of this report. 557 references. (auth)

58307 NUCLEAR SAFETY. VOLUME 13, NUMBER 5. Cottrell, Wm. B.; Blakely, J. Paul; Jordan, W. H. One of Four Technical Progress Reviews Published for the Technical Information Center, USAEC. Oak Ridge, Tenn.; Oak Ridge National Laboratory (1972). 99p. GPO $0.60.

Separate abstracts were prepared for the 9 included papers. (M.O.W.)

For abstracts of individual papers see: 56101, 56408, 56409, 57833, 58069, 58080, 58308, 58408, and 58409.

58308 SAFETY-RELATED OCCURRENCES REPORTED IN APRIL—MAY 1972. Casto, William R. Nucl. Safety; 13: No. 5, 406-8(1972).

Occurrences reported include: damage to steam generator tubes, heat tracing system not hooked up, BWR jet pumps partially plugged, flow switch failure, liquid system explosive valve failure, and feedwater regulating valve failure. (M.C.G.)

58309 NUCLEAR SITING CONTROVERSY IN THE UNITED STATES OF AMERICA. Shaw, J. (Queen Mary Coll., London). J. Inst. Nucl. Eng.; 13: No. 3, 85-90(1972).

UK reactor sites now being built may be less remote due to development of prestressed concrete pressure vessels, which improves safety. There is little public objection to this policy. In the USA the number of objectors to potential radiative and thermal pollution has risen as public interest in the environment increases. The main issues are the need for reliable emergency core cooling systems in the event of a large release of radioactivity, the need for low levels of radioactivity release at site boundaries, thermal pollution of water, and storage of long-lived radioactive wastes. Groups of objectors forced the withdrawal of some site applications and have delayed licensing. Licence delays are caused also by the revision of the Atomic Energy Commission rules to comply with new Acts protecting the environment. (UK)

58310 SITING OF NUCLEAR POWER STATIONS IN ENGLAND AND WALES. Groom, D. J. (Central Electricity Generating Board, London). J. Inst. Nucl. Eng.; 13: No. 4, 99-105(Jul 1972).

The subject is reviewed under the following headings: Power station siting strategy (coal-fired stations, oil-fired stations; nuclear stations); remote siting of Magnox stations (Government policy; cooling water requirements; population considerations); relaxation of remote siting policy; environmental effects (statutory duties; nuclear installations act; radioactive substances act; tidal environment; physical effects; biological effects; radioactive liquid effluents; gaseous discharges; environmental monitoring; and impact on the public). (UK)

58311 ATOMIC POWER SAFETY: A COMMON SENSE APPROACH. Norwood, William D. (Hanford Environmental Health Foundation, Richland, Wash.). J. Amer. Med. Ass.; 221: No. 12, 1392-6(18 Sep 1972).

All sources of fuel are needed to supply the increasing power needs of a growing population. Atomic fuel competes economically with fossil fuels under most conditions and eliminates undesirable environmental pollution by stack effluents. Both fossil- and atomic-fueled plants have waste hot water which necessitates controls to prevent changes in the ecology. The 25-year record of health and safety of atomic energy programs in the United States should be comforting to the public. Radiation exposures from commercial power reactors have been a very small fraction of permissible limits, and the Atomic Energy Commission has recently further restricted releases from such reactors so that the average exposure to the public will be only about 1% of that from the natural background. (15 references)

58312 SAFETY REQUIREMENTS FOR NUCLEAR POWER PLANTS. Crancher, D. W. (Australian Atomic Energy Commission, Lucas Heights). At. Energy Aust.; 15: No. 1, 9-18 (Jan 1972).

A high degree of containment is required to minimize the release of fission products and activated coolant from reactors. Under normal operation, discharge limits are so low that no health effects can be attributed to plant operation. It is necessary to continually study possible accident mechanisms to maintain safety records. Loss-of-coolant accidents are considered the most serious—the likely chain of events following such an accident is outlined. Measures taken to protect against accidents are strict control of plant engineering design, construction and operation, provision of safety systems independent of the basic plant equipment, the presence of a leaktight containment building, and siting restrictions. Regulatory control of nuclear power in most countries involves licensing and regulation of nuclear installations generally accompanied by government-backed indemnity. Licensing provisions are outlined and site selection, construction permit, and operating license procedures are described. The technical aspects of the licensing process are considered from the points of view of safety assessment procedure and compliance. (Australia)

58313 SOME REMARKS ON FAILURE DETECTION IN NUCLEAR POWER REACTORS BY NOISE MEASUREMENTS. Schwalm, D. (CCR—EURATOM, Ispra, Italy). Atomkernenergie; 19: No. 4, 263-70(Jul 1972).

A method for detection and location of vibrating reactor components by noise measurements is proposed. In addition, triangulation techniques are discussed for locating and identifying some anomalies in the reactor core. Finally, some relations for at-power noise measurements are derived which may also be used for the diagnosis of malfunctioning reactor components. (64 references) (auth)

58314 EMERGENCY COOLING OF A 37-ROD CLUSTER BY HEAT RADIATION. Hufschmidt, W.; Burck, E.; Hoffmann, H. (EURATOM, Ispra, Italy). Atomkernenergie; 19: No. 4, 307-11 (Jul 1972). (In German).

After an accident in the primary circuit of a PWR and a simultaneous failure of the emergency cooling system for the fuel elements, the decay heat can be extracted only by means of heat radiation and conduction. For a 37-rod cluster in Zircaloy, it was experimentally shown that this cooling system is not sufficient. (auth)

58315 IMPROVEMENT OF THE LEAKAGE INSPECTION OF SAFETY EQUIPMENT AT NUCLEAR REACTORS. Bongers, H. J. G. (NV KEMA, Arnhem, Netherlands); Hoogeveen, G. P. Elektrotechniek; 50: 473-8(25 May 1972). (In Dutch).

The safety equipment of the nuclear power station at Dodewaard showed persistent leakages. A number of inspections and tests were made in order to obtain a tightness of 100% at pressures up to 95% of the working pressure without using auxiliary excitation. This purpose has been reached. A complete tightness has been achieved after blowing off steam. (auth) (Netherlands)

58316 SAFETY CONCEPT AND RESPECTIVE CONSTRUCTION CHARACTERISTICS OF THE SNR 300. Brandstetter, A.; Huebel, H. (INTERATOM, Bensberg, Ger.). Atomwirt., Atomtech.; 17: No. 7, 371-4(Jul 1972). (In German).

At its meeting in December 1971, the reactor safety commission approved the safety concept of the SNR 300. Thus, the concept can be considered established. Nevertheless, the safety procedures may be influenced during the licensing process. Described in detail are safety technical aspects, preventive safety procedures as well as the construction characteristics and procedures for control of hypothetical emergencies. (tr-auth)

Steam and Power Conversion System

58317 NUCLEAR STEAM GENERATORS AND LMFBR IHX'S: TECHNICAL SURVEY NO. 8. Nucl. Eng. Int.; 17: No. 194, 541-55(Jul 1972).

The survey consists of four articles in which are discussed the production of standardized steam generators for Westinghouse PWR's, the development of helical steam generators for gas-cooled reactors, advantages of once-through steam generators in PWR's, and the design of generators for use with liquid-metal-cooled fast reactors. A table is presented listing manufacturers of nuclear steam generators and intermediate heat exchangers for fast reactors, and giving company information, available facilities, and technical details of the equipment. (UK)

58318 MODEL T STEAM GENERATOR PRODUCTION. Nucl. Eng. Int.; 17: No. 194, 541-3(Jul 1972).

Manufacturing procedures for the production of standard steam generators for Westinghouse PWR's are described. The 300,000-kW generators 68 ft long and 14 ft dia, weighing 330 tons, consist of the larger evaporator section containing the bank of U-tubes for the primary coolant, and the upper section with two-stage steam separators. The two sections are welded together in the final assembly stages. Facilities are available for direct transfer to ocean-going ships. (UK)

58319 HELIX STEAM GENERATORS FOR GAS-COOLED REACTOR SYSTEMS. Luescher, O. (Sulzer Brothers Ltd., Winterthur, Switzerland). Nucl. Eng. Int.; 17: No. 194, 543-6(Jul 1972).

The characteristics of helical steam generators for the Lucens and EL 4 reactors and also for the prototypes Fort St Vrain and THTR are presented. The extent of the development work involved in the design and operation of this type of generator is illustrated by consideration of four main problems in the fields of heat transfer, tube vibration, wear and surface damage due to fretting, and thermal shock. (UK)

58320 ONCE THROUGH STEAM GENERATOR BOOSTS PWR CYCLE EFFICIENCY. Sankovich, M. F.; McDonald, B. N.

(Babcock and Wilcox Co., Barberton, Ohio). Nucl. Eng. Int.; 17: No. 194, 546-8(Jul 1972).

Once-through steam generators supply superheated steam without recourse to either steam separators or scrubbers. They can therefore conveniently be shop assembled and tested and then delivered directly to the plant. Other advantages of the once-through system are a lower heat rate, production of moisture-free steam, constant steam pressure, and a purity of feedwater such that frequent blowdowns are unnecessary. (UK)

58321 STEAM GENERATORS FOR LIQUID METAL COOLED FAST REACTORS. Bennett, J. C. (Clarke Chapman-John Thompson, London). Nucl. Eng. Int.; 17: No. 194, 548-50(Jul 1972).

Special design problems associated with the use of liquid metal as a primary heat exchange medium are discussed. The consequencies of tube leaks leading to sodium—water reactions, the importance of the integrity of the materials used, and the necessity for high standards of reliability at all stages are discussed. The use of intermediate heat exchangers is a feature likely to be retained for early civil fast reactors. Of the tube configurations considered, the straight tube design is too unwieldy, so that the final choice lies between the U-tube in cylindrical shell configuration and the helical concept. (UK)

Propulsion and Auxiliary Power Reactors

Refer also to abstracts 55973 and 58079.

58322 ENERGY SUPPLY AND ENERGY CONVERTERS IN SATELLITES AND SPACE VEHICLES. Peschka, Walter (Deutsche Forschungs- und Versuchsanstalt fuer Luft-und Raumfahrt E. V., Stuttgart). VDI (Ver. Deut. Ing.) Z.; 113: No. 18, 1451-3(Dec 1971). (In German).

A summary is presented of the most recently proposed energy sources: chemical batteries, radioisotopes, and nuclear reactors. The list of energy converters includes solar cells (silicon, thin-layer CdS), mechanical-electrical types (radioisotope- or reactor-heated Rankine and Brayton systems), thermoelectric (semiconductors with nuclear energy sources), thermionic (incore thermionic reactors), and inductive magneto-fluid-dynamic converters which depend upon considerable advance in high-temperature alkali metal technology for their future success. 51 references. (K.S.W.)

58323 MOTIVE POWER FOR CARRIER ROCKETS AND SPACE VEHICLES. Reichel, Rudolf H. VDI (Ver. Deut. Ing.) Z.; 113: No. 18, 1444-8(Dec 1971). (In German).

Various types of rockets consist of four categories: chemical, nuclear energy, electrical, and novel concepts. The chemical category includes the Saturn V 2nd and 3rd stage liquid fuel, H_2-O_2, solid fuels, and hydrides. A brief description of the NERVA-Program is presented for the nuclear category. The electrical power includes thermoelectric, electrostatic, and electromagnetic versions. The list of 87 references is presented. (K.S.W.)

58324 DESIGN POINT CHARACTERISTICS OF A 15- TO 80-kW$_e$ NUCLEAR-REACTOR BRAYTON-CYCLE POWER SYSTEM. Kerwin, Paul T. (Lewis Research Center, Cleveland). pp 376-81 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A study of a 15- to 80-kW(e) nuclear-reactor-powered Brayton-cycle power system is presented. The system has a design turbine inlet temperature of 1150°F based on the use of a zirconium-hydride reactor but is also required to be capable of operation at turbine inlet temperatures up to 1600°F with an advanced reactor. Considerations involved in the selection of cycle parameters, working fluid, pressure level, and turbomachinery rotational speed are discussed. Size and weight estimates and predicted design-point performance and required radiator area are presented. (auth)

58325 PREDICTED PERFORMANCE OF A 15- TO 80-kW$_e$ REACTOR BRAYTON POWER SYSTEM OVER A RANGE OF OPERATING CONDITIONS. Guentert, D. C.; Johnsen, R. L. (Lewis Research Center, Cleveland). pp 382-6 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A computer simulation of a 15- to 80-kW(e) nuclear reactor Brayton cycle power system designed for a turbine inlet temperature of 1150°F was used to study the steady-state performance of the system at turbine inlet temperatures between 1050 and 1600°F. The low end of the temperature range is of interest in applications using a zirconium hydride reactor heat source, while the 1600°F temperature assumes the use of an advanced reactor. Cycle-parameter effects and predicted system efficiency and required radiator area are presented over a range of compressor inlet temperatures and turbine inlet temperatures. The performance over a range of power levels is also presented. (auth)

58326 POTASSIUM TESTING OF CONDENSATE REMOVAL DEVICES FOR RANKINE SPACE POWER TURBINES. Rossbach, R. J. (General Electric Co., Idaho Falls, Idaho); Kaplan, G. M. pp 409-21 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Nuclear Rankine power plants for space vehicles, like their earth-bound counterparts, have turbines which operate condensing. It is necessary to remove the condensate as it forms in the turbine to prevent blade erosion and to improve turbine efficiency. Two types of condensate removal devices for vapor turbines and a third device to be used between high- and low-pressure turbines were tested in a three stage turbine using potassium vapor. The vortex separator, for use between turbines, had the highest effectiveness (defined as the fraction of condensate entering the separator (or stage) removed) of the three devices tested. The rotor condensate removal devices confirmed results available in the steam turbine industry and the results indicate that the turbine blading can be adequately protected from erosion. The stator condensate removal device had effectiveness values too low for adequate erosion protection, confirming earlier air-water tests. (auth)

58327 REACTOR POWER SYSTEM APPLICATION TO THE EARTH ORBITAL SPACE STATION. McGrath, R. E.; Coggi, J. V. (McDonnell Douglas Astronautics Co., Richland, Wash.). pp 422-32 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Reactor power system modules are defined for the 12-man Earth Orbiting Space Station. Both reactor-Brayton and reactor-thermoelectric power conversion systems are designed and integrated with a growth-capable version of the 33-foot-diameter station. The Space Station mission requires periodic artificial gravity (station rotation) and the requirement has major impact on the Space Station and power system configurations. The resultant designs provide integral launch of the reactor power system and Space Station with provisions for reactor deployment, startup, and verification prior to station manning. The reactor power systems are packaged as modules and are designed for resupply via the reusable Space Shuttle vehicle; thus, the power system designs meet launch requirements for both the INT-21 booster and the Space Shuttle booster. The growth-capable station design accommodates a 50% increase in both crew size and experiment capability. Consequently, a similar power-growth capability is a major factor influencing the power system design approach. Key criteria for power system evaluation and comparison include growth capability, program-change response, development risk, and reliability. Evaluations based on these criteria are very favorable since both reactor power system designs have growth capability of 50% or more. Benefits from the design approach are obtained at the baseline power level of 29 kW(e) due to system derating, in the form of either reduced operating temperatures or gross power levels. The benefits include reduced development risk, increased system lifetimes, reduced maintenance, and applicability for a wide range of power. System derating allows operation, even with state-of-the-art conversion or power source assemblies with limited impact on system growth and lifetimes. The thermoelectric power module weighs 27,770 pounds, has a radiator area of 3800 ft^2 including a supplementary radiator on the deployment boom, and has a power growth capability of 41.5 kW(e). The Brayton power module weighs 26,016 pounds and has a radiator area of 2000 ft^2 and a power growth capability of 53.5 kW(e). The 10-year power system weights are 94,300 and 89,600 pounds for the thermoelectric and Brayton systems, respectively. (auth)

58328 NUCLEAR SAFETY CONSIDERATIONS FOR MANNED SPACE FLIGHT. Gerrels, E. E. (General Electric Co., Philadelphia); Stafford, W. H. pp 433-41 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Some of the principal nuclear safety considerations involved in the launch and orbital operations of future earth orbital manned space stations are discussed. Design and operational guidelines are recommended for the elimination or control of nuclear hazards resulting from space nuclear reactors, isotopic sources and radiation associated with the natural space environment. Areas of investigation include radiation interactions with the crew, subsystems and facilities, experiments, photographic film, interfacing vehicles and the nuclear hardware. Consideration of such nuclear safety guidelines is planned for use in subsequent phases of NASA space programs to increase mission effectiveness and overall system safety. (auth)

58329 NUCLEAR REACTOR DISPOSAL CONSIDERATIONS FOR MANNED SPACE VEHICLES. Caruvana, A.; Killen, R. E. (General Electric Co., Philadelphia). pp 442-51 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The principal safety aspects associated with disposal of the zirconium hydride reactor(s) for the proposed Space Base mission are discussed. Reactor system design changes are recommended to minimize the possibility of a hazardous accident during the disposal operation; these include a positive shutdown mechanism and provision for a reactor reentry protection shield. The use of a Remote Maneuvering Unit (RMU) which would place the reactor assembly in an orbit with a 300–500 year lifetime is selected as the preferred disposal method. (auth)

58330 COMPONENT AND OVERALL PERFORMANCE OF AN ADVANCED RANKINE CYCLE TEST RIG. Bond, J. A. (General Electric Co., Idaho Falls, Idaho); Gutstein, M. U. pp 464-71 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

Experimental measurements of component and overall performance of an advanced Rankine cycle test rig are presented. The facility is a three-loop system in which lithium, potassium and NaK-78 are the working fluids of the primary, secondary, and heat rejection loops, respectively. Component performance results are presented for the electrical lithium heater, the helical induction EM pumps, the high temperature potassium valves, the once through potassium boiler and the three-tube potassium condenser. The results of an exploratory transient test to simulate a liquid-injection startup of a Rankine cycle system are also presented. (auth)

58331 HEAT-PIPE COOLED REACTOR AND HEAT EXCHANGER FOR BRAYTON-CYCLE POWER SYSTEMS. Frank, T. G.; Grover, G. M.; Anderson, R. C.; Sutherland, C. D.; Swickard, E. O. (Los Alamos Scientific Lab., N. Mex.). pp 472-7 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A shielded reactor and heat-exchanger design is presented which can be coupled with three 10- to 15-kW(e) Brayton-cycle turbines to provide a 30- to 45-kW(e) space power supply. Although not restricted to this application, the operating conditions specified for the reactor and heat exchangers are consistent with the requirements of the 10- to 15-kW(e) Brayton-B power system being developed by NASA. The shielded reactor and heat-exchanger designs are characterized by low weight and by highly reliable and redundant components. Some important features of the system are: (1) Heat transfer from the reactor core to the heat exchangers is accomplished by means of heat pipes. They are included in sufficient number and with sufficient heat-transfer capability to ensure continued operation of the reactor in the event of isolated heat-pipe failures. (2) The fuel may be either UN or UC; power density and temperature during operation are kept within limits that should ensure several years of lifetime with little fuel swelling and little, if any, release of fission products. Space is easily provided to accommodate any anticipated fuel swelling. Gaseous fission products that may be released from the fuel are doubly contained. (3) Reactor afterheat is automatically radiated to space by means of a set of auxiliary heat pipes in case of emergency shutdowns. (4) Three fin-and-tube type heat exchangers, one for each of the Brayton-cycle turbines, are included in a manner that permits continued operation of operable units in the event of failure of one or more of the power subsystems. (5) Redundancy in reactor control is obtained by means of 13 control rods not all of which are essential for control or shutdown of the reactor. (auth)

58332 SMALL BOILING ORGANIC REACTOR POWER PLANT. Copenhaver, Carl M. (Oak Ridge National Lab., Tenn.). pp 768-74 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A system analysis is presented for a 100 kW(e) direct-cycle boiling organic reactor plant designed for remote area use. An unusual self-regulation feature is combined with the use of organics to significantly reduce both capital and operating costs resulting in an estimated power cost of 128 mills per kW(h). The design reactor core life is 10 years and the plant gross cycle efficiency is 29.1%; reduced to 21.9% principally by a hydrocracking unit to correct for organic decomposition. The reactor utilizes separate organic regions for the moderator and coolant and is designed so that the void coefficient of reactivity is positive in the normal operating condition but becomes strongly negative at very high void fraction. This variable void coefficient design characteristic provides for the inherent self-regulation feature. Included are: a description of the plant and key features; aspects of using organic as a primary coolant; some discussion of periodic maintenance concept; and a breakdown of the power cost. (auth)

58333 THERMIONIC REACTOR TECHNOLOGY: AN OVERVIEW. Beard, D. S. (Atomic Energy Commission, Washington, D. C.). pp 933-8 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

An overview of the thermionic reactor technology efforts being conducted under government sponsorship in the United States is presented and the progress since the 1970 IECEC conference highlighted. The relationships of the technology development approach to power system concepts for possible space and special terrestrial applications are shown. Applicability of the technology being developed for thermionics is reviewed relative to possible applications or utilization in other fields. The thermionic reactor technology programs of France, Germany and the Soviet Union are briefly reviewed and compared with the U.S. program objectives and schedule. (auth)

58334 THERMIONIC REACTOR DEVELOPMENT. Holland, J. W.; Fisher, C.; Gietzen, A. J.; Homeyer, W. G.; Perry, L. W. (Gulf General Atomic Co., San Diego, Calif.). Contract AT(04-3)-167. pp 939-47 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

A multicell thermionic fuel element (TFE) has been operated for one year. Reactor and systems analysis shows that the TFE presently under development when incorporated into reactors of appropriate size will competitively fulfill the power needs in space over the range from tens of kilowatts to hundreds of kilowatts. The most recent system design was of a 40 kW(e) U–ZrH driver thermionic reactor for application on the NASA Space Station. An experiment to test a prototype thermionic reactor is planned. (auth)

58335 PERFORMANCE OF THE THERMOELECTRIC CONVERTER FOR THE ZIRCONIUM HYDRIDE REACTOR SPACE POWER SUPPLY. McCourt, P. E. (Atomics International, Canoga Park, Calif.); Roberts, D. R.; Du Val, R. A. Contract AT(04-3)-701. pp 948-55 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The ZrH reactor thermoelectric system is being evaluated for application in the NASA Space Station Program and in unmanned satellite programs. The PbTe converter for these systems is composed of individual tubular modules coupled to the reactor and to the rejection radiator NaK loops. Testing of the individual tubular modules continues in both electrically heated test systems and in flowing NaK test systems simulating operational temperature and flow profiles. Data from module tests to demonstrate the elimination of internal module distortion during temperature cycling and the elimination of materials transport as a contributor to internal module resistance increase with time are presented. A description of key operational performance parameters and summary of the progress in materials technology and design directed towards increased converter performance are included. (auth)

58336 TESTING AND PERFORMANCE SIMULATION OF AN AIR-COOLED THERMOELECTRIC MODULE. Merrifield, D. V.; Young, L. E. pp 970-8 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The status and interim results of a tubular compact thermoelectric module test and evaluation program is described. As of 6,800 hours of endurance testing, which included several performance tests, the power output of the AEC-developed module had decreased approximately 5.5%. In conjunction with performance mapping of the module, computerized mathematical models have been developed which can simulate its thermal/electrical performance characteristics as a function of specified operating conditions. The models are intended for use in space reactor-thermoelectric power system integration studies. Agreement of model data with test data is generally within 2%. (auth)

Process Heat and Desalination Reactors

Refer also to abstracts 58079 and 58107.

58337 (CONF-720627–, pp 6.0-26) MATTER OF NUCLEAR PRIORITIES: WATER AND/OR ELECTRICITY. de Bruin, H. J. (Flinders Univ. of South Australia, Bedford Park).

From Symposium on the role of nuclear energy in Australia's development; Canberra, Australia (1 Jun 1972).

Basic concepts and principles of nuclear desalination technology are summarized with particular reference to cost. A comparison is made between the economic viabilities of introduction of nuclear technology into the electricity and water supply industries in Australia. It is suggested that local nuclear effort should be concentrated on the problem of desalination. (M.R.M.)

58338 (ORNL-NDIC–13) INDEXED BIBLIOGRAPHY OF NUCLEAR DESALINATION LITERATURE-7. Johnsson, K. O. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 64p. Dep. NTIS.

Abstracts are given for approximately 200 published articles related to the desalination of seawater. The body of the report is a copy of information stored in a computerized storage and retrieval system for the Nuclear Desalination Information Center (NDIC) at the Oak Ridge National Laboratory. The abstracts are grouped in ten categories (and repeated if they fall into more than one category). An author index and a keyword index to the articles referenced are provided. The keywords, which identify the content of the articles were chosen from a thesaurus developed by NDIC. (auth)

58339 EXAMINATION OF THE POSSIBLE ROLE OF NUCLEAR ENERGY IN THE INDUSTRIAL HEAT MARKET. Thiriet, L. (CEA, Paris). Chim. Ind., Genie Chem.; 105: No. 9, 579-89 (Apr 1972). (In French).

The potential economic advantages of nuclear energy in the heat market are analyzed: reactors of the same thermal power requiring identical expenditures supply heat at an identical cost for all output temperatures of the coolant; reactors having the same electrical power requiring identical expenditures are favored for steam production (low coolant output temperatures being advantages). Comparison between the nuclear and the classical thermal methods can be made in the first approximation in terms of two simple criteria: the level of the investment, i.e. the total equivalent electrical power (heat + electricity) of the plant, and the heat energy/electrical energy ratio. The potential market of heat-producing nuclear reactors was examined: desalination; domestic uses; industrial uses other than desalination. Certain overall estimations of the world market of mixed reactors are indicated, and areas in which heat producing nuclear reactors are likely to have advantages are mentioned. (France)

58340 INTEGRATION OF DISTRICT-HEATING NUCLEAR POWER PLANTS INTO INTERCONNECTED POWER SYSTEMS. Halzl, Josef; Szabo, Zoltan; Torma, Miklos. Energ. Atomtech.; 24: No. 11, 454-61(Nov 1971). (In Hungarian).

Operational conditions of nuclear district-heating power plants and their expected role in the power systems are analyzed. Because of the increased length of the district-heating network compared to conventional district heating systems, efforts have to be made to reduce the specific investment costs of heat distribution. Proposals are made for combination of district heating with electrical heating, which not only reduces the costs of heat distribution but also helps to utilize cheap off-peak nuclear power. A combination of district heating with hot water production using off-peak nuclear power is described by which, in addition to reducing the capacity requirement of the district heating network, offers an attractive solution to the problem of hot water supply in the summer. If there is a demand for district cooling in the summer period beside the heating requirements in winter, the combination of district heating with a heat pump might become an economic proposition. If the distance between the power plant and the residential area is great, the heat pump alone might become competitive. (auth)

58341 PROBLEM OF SELECTING A REACTOR TYPE FOR ATOMIC DISTILLATION INSTALLATIONS. Ulitícheva, V. N. Nauch. Tr. Mosk. Inzh.-Ekon. Inst.; No. 29, 103-10(1970). (In Russian).

Correlation analysis established the fundamental economic factors for atomic power stations using thermal neutrons: the unit capital expenditure and cost of electrical power as a function of power unit size, net efficiency, and degree of combustion of the nuclear fuel. The advantage of an atomic power station with boiling water reactors over other types of thermal neutron reactor systems was brought out. The construction of seawater distillation installations based on thermal reactors planned for the next few years is possible only if there is a high degree of concentration in terms of the unit power of the installation and of the station as a whole. (JPRS)

Research and Test Reactors

Refer also to abstracts 56267, 58079, 58092, 58107, 58305, 58306, and 58390.

58342 (ANCR–1019(Rev.1)) SELECTION, TRAINING, AND QUALIFICATION OF PBF PERSONNEL. (Aerojet Nuclear Co., Idaho Falls, Idaho). Aug 1972. Contract AT(10-1)-1375. 53p. Dep. NTIS.

Specific training responsibility and organizational relationships are discussed. Training and qualification outline, individual qualification prerequisites and requirements, and individual training and qualification records requirements are given. (7 references) (auth)

58343 (ANCR–1084) EVALUATION OF ETR STABILITY VIA ROD DROP EFFECTS. Gossmann, S. R.; Phelps, F. R. (Aerojet Nuclear Co., Idaho Falls, Idaho). Aug 1972. Contract AT-(10-1)-1375. 33p. Dep. NTIS.

During the summer and fall of 1971 the ETR intermittently exhibited small periodic power variations. Autonomous oscillation of the reactor was not thought to be the source of these variations because of observed weak power dependence. In order to confirm this opinion, a stability analysis of the reactor was performed using data obtained from a rod drop experiment. The details of the analysis, with the conclusion that the observed power variations could not have been the result of reactor instability or autonomous reactor oscillation, are presented. 6 references. (auth)

58344 (CEA-N–1523) OSCILLATION EXPERIMENTS IN CESAR: AXIAL EFFECTS; INTERPRETATION OF EXPERIMENTS. Bouedo, Yves (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1972. 150p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

The results obtained on the oscillation of U–Pu samples in the graphite moderated reactors: MARIUS and CESAR (measurements at 20, 200, and 400°C in CESAR) are analyzed. The importance of axial problems in analyzing the results is studied. Results obtained at different temperatures are presented. Discrepancies exist between the experimental and theoretical values of the absorption and fission reaction rates and the eta values. The discrepancy is a function of temperature. A comparison of these results with the effective cross-sections calculated from fundamental data suggest a consistent set of cross sections for ^{235}U and Pu isotopes: the shape of the first 1 eV resonance of ^{239}Pu is modified; only the 2200 m/s cross section values are different for the other isotopes. 20 references. (auth)

58345 (FMRB–39/72) REPORT OF EXPERIENCE IN THE MANAGEMENT AND RADIATION PROTECTION OF THE BRUNS-

WICK RESEARCH AND MEASUREMENT REACTOR (FMRB) FOR THE YEAR 1971. Heintz, W.; Siegel, V. (Physikalisch-Technische Bundesanstalt, Brunswick (East Germany)). Jun 1972. 31p. (In German). Dep. NTIS (U. S. Sales Only).

The experience in the operation of the Research and Measurement Reactor, Brunswick, and in radiation protection work is reported for the year 1971. No serious problems arose. The generated energy was 2110 MWh in 1971. (auth)

58346 (GEAP–13771-3) CRITICAL EXPERIMENTS AND COOPERATIVE EVALUATIONS PROGRAM. Third Quarterly Report, April–June 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jul 1972. Contract AT(04-3)-189. 57p. Dep. NTIS.

Current activities and technical progress for the period April through June, 1972, are reported for two tasks. Task A covers the planning and analysis of critical experiments in ZPPR-3. Task B progress is reported for nuclear data evaluation and testing and methods development in support of Task A. (auth)

58347 (GKSS–72/E/1) FRG-0 II EXPERIMENT. Fifth Status Report, Condition 6/30/71. Anuschewski, P.; Baumgart, R.; Boessow, E.; Lahann, H.-J.; Martens, P.; Mertins, H.; Krull, W.; Krueger, A.; Wrobel, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht (West Germany)). 1972. 56p. (In German). Dep. NTIS (U. S. Sales Only).

The fifth status report of the FRG-O-II experiments describes two types of measurements on complex core charges. Among the core charges studied, that with central absorber yielded the greatest power. In addition, measurements and calculations of the thermal neutron spectrum are reported and discussed for four different core charges. For β_{eff}-measurements according to the absorption method, the boron content of B–Al plates was calculated. Applicability of an approximation formula for ρ values of control rods was studied. (tr-auth)

58348 (GKSS–72/E/2) FRG-0 II EXPERIMENT. Sixth Status Report, Condition 12/31/71. Baumgart, R.; Borchers, D.; Boessow, E.; Kolb, M.; Krull, W.; Marmotti, M.; Martens, P.; Taha, M.; Wrobel, W. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1972. 50p. (In German). Dep. NTIS (U. S. Sales Only).

The sixth status report of the FRG-O-II experiments describes measurements of both neutron flux distribution and reactivity of a complex core charge. In addition, measurements of the thermal neutron spectrum are given and discussed for four different core charges. Also reported are calibration measurements for reactivity as well as automation of β–γ- coincidence measurements. (tr-auth)

58349 (JAERI-M–4538) RADIATION MONITORING SYSTEM FOR THE JMTR. Okuyama, Noboru; Mito, Norio (Japan Atomic Energy Research Inst., Tokyo). Aug 1971. 74p. (In Japanese). NTIS (U. S. Sales Only).

In the radiation monitoring system for JMTR (Japan Material Testing Reactor, 50 MW) in the Oarai Research Establishment, newly developed devices and techniques are used— experience gained in radiation monitoring in the Tokai Research Establishment is included. The fundamental ideas on which the types, numbers and positions of health-physics monitors and sampling devices are based are described, and also the performance of these monitors and their arrangement. (auth) (Japan)

58350 (JAERI-M–4566) IN-CORE NEUTRON FLUX MEASUREMENT WITH A FISSION CHAMBER. Tojo, Takao; Kondo, Makoto; Shiraishi, Tadao; Itoh, Kazuyoshi; Hashimoto, Kazuyuki (Japan Atomic Energy Research Inst., Tokyo). Sep 1971. 23p. (In Japanese). NTIS (U. S. Sales Only).

Thermal neutron flux distributions in a vertical experimental hole (S-pipe) of Japan Research Reactor No. 4 (swimming-pool type) have been measured with an in-core fission chamber (WL-23284, Westinghouse). Self-powered detectors of Rh and Co emitter, respectively, were also used for comparisons in the measurements. The thermal neutron flux distributions were measured for various patterns of the control rods in order to observe the effect of the pattern on the flux distribution. The measurements in the S-pipe showed that there was relatively large dependence of the flux distribution on the position of a regulating rod, and the integrated flux varied about 7 percent at maximum, with the position of the control rod. On the other hand, the influence by the position of shim-rods on the distribution was not clearly observed. Characteristics of the in-core chamber, such as linear relationship between detector output current and reactor power, and thermal neutron sensitivity, were also measured during the experiment. The temperature distribution measured in the experimental hole is given. In the measurement, a chromel–alumel thermocouple attached to the self-powered detector of Rh emitter was used. (auth)

58351 (JAERI-Memo–4076) ANALYSIS OF THE TCA VOID EXPERIMENT USING FOAMED POLYSTYRENE BLOCKS. Takeuchi, Eiji; Takeda, Renzo (Japan Atomic Energy Research Inst., Tokyo). Jun 1970. (In Japanese). NTIS (U. S. Sales Only).

As a part of the JP-II core final design study, the effects of voids on power distribution were investigated, using foamed polystyrene blocks with equivalent void fraction of 33% to 53%. Comparisons made between experiment and calculation indicated that the calculation model and the design technique applied to the JP-II core design were satisfactory. The feasibility of estimate of void distribution in the core is also discussed. (auth)

58352 (ORNL-TM–3966) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, APRIL, MAY, AND JUNE OF 1972. Tabor W. H.; Hurt III, S. S. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 56p. Dep. NTIS.

The ORR operated at an average power level of 29.8 Mw for 88.1% of the time ($\sim$1,924 hrs) during April, May, and June 1972. Eight fuel elements were declared spent (^{235}U content $\sim$120 g) with an average burnup of 54.2%, while two shim-rod elements were retired from service at an average burnup of 86.3%. Reactor downtime for eight shutdowns totaled $\sim$259 hrs, of which only 0.6 hrs was unscheduled. End-of-cycle shutdowns accounted for 80.7% of the total downtime, with the remainder used principally for refueling and experiment work. Maintenance activities, both mechanical and instrument, were essentially routine in nature. Special tests or measurements made during the quarter included: (1) temperature measurements of spent fuel, (2) reactivity and flux measurements for experiments proposed by Gulf General Atomic and General Electric, and (3) shim rod calibration. (auth)

58353 (ORNL-TM–3971) HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT, APRIL, MAY, AND JUNE OF 1972. McCord, R. V.; Corbett, B. L. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 23p. Dep. NTIS.

Reactor on-stream time was only 90.9% this quarter which reduced the operating time percentage for the year to 93.1. Shutdowns to replace all the reactor vessel top head studs and to inspect broken flow monitoring lines inside the reactor vessel caused the reduction in operating time. (auth)

58354 (ORO–4015-3) THIRD ANNUAL PROGRESS REPORT CONCERNING ACTIVITIES CONDUCTED UNDER THE REACTOR SHARING PROGRAM. (Texas Engineering Experiment Station, College Station). Oct 1972. Contract AT(40-1)-4015. 8p. Dep. NTIS.

An administrative report of the operation of the Texas A&M Research Reactor under the Reactor Sharing Program is given. In addition to Texas A&M, the following institutions are involved in the program: Baylor University, University of Texas at Austin, Prairie View A&M College, Lamar State University, and Rice University. (J.M.J.)

58355 HIGH FLUX FRANCO–GERMAN REACTOR. FUEL HANDLING. Loehr, G. (Society for Nuclear Research, Karlsruhe, Ger.). Bull. Inform. Sci. Tech. (Paris); No. 165, 67-70 (Dec 1971). (In French).

Fuel handling equipment is used to place new elements in the pile or to remove irradiated elements. This equipment is also used to change the shim rod. Two devices are used to discharge the irradiated fuel elements, and a third device is used to charge the reactor with new fuel elements or to change the shim rod. The discharging devices are essentially different from the charging device, a heat exchanger being provided in the former, which permits their cooling by natural convection. The charging and discharging operations are performed using light water protection (7.70m) afforded by the swimming pool and the adjacent channel. The charging and discharging devices are connected in a liquid-tight manner to the pile-block such that the demineralized water of the swimming pool does not mix with the heavy water of the pile-block during the fuel handling operations. (France)

58356 UNFOLDING OF PULSE HEIGHT DISTRIBUTIONS DUE TO LOW ENERGY GAMMA-RAY. Nakashima, Yoshiyuki (Nagoya Univ., Japan); Minato, Susumu; Kawano, Minoru; Tsujimoto, Tadashi; Katsurayama, Kousuke. Nippon Genshiryoku Gakkaishi; 14: No. 1, 2-10(Jan 1972). (In Japanese).

A 30 × 30 response matrix was derived to evaluate low energy (10 ~ 200 keV) γ-ray spectra for a measuring system which consisted of a scintillation counter coupled with a 25 mmϕ × 2 mmt NaI(Tl) crystal, a collimator and a log-amplifier. The collimator was used to measure a comparatively parallel beam incident on the scintillator, and the log-amplifier for magnifying the pulse height distribution of low energy γ-rays. The observed pulse height distributions were unfolded by iterative method with an automatic computer using the response matrix. An incident γ-ray spectrum for ^{203}Hg unfolded by the method coincided within 10% with the values estimated by the "Table of Isotopes". This method was applied to evaluate low energy γ-ray spectra around a nuclear reactor. The pulse height distributions were observed at a place close to the thermal column of the KUR (Kyoto University Reactor) at 5 MW thermal output. The results showed that low energy γ-rays leaking through the reactor shielding were comparatively weak, and that high energy γ-rays, when leaking, became low energy by scattering in the air. (auth)

58357 RESEARCH NUCLEAR REACTORS: SKODA. Plzen, Czech.; Skoda [(1971)]. 14p. (In Czech and English).

Design parameters and operations aspects of the SR-OA Assembly and the SR-1 Research Reactor are presented. (D.C.C.)

58358 HIGH FLUX REACTOR AT THE INSTITUT LAUE-LANGEVIN. Ageron, P. (CEN, Grenoble, France). Endeavour; 31: No. 113, 67-72(May 1972).

The high thermal flux reactor at Grenoble now in process of completion was constructed as a powerful and specialized neutron source for fundamental research in nuclear and solid-state physics. Examples of such research, such as the physics of the condensed state to investigate the properties of amorphous substances and liquids, and nuclear physics to study radiative capture and fission, are discussed. The choice of the high-intensity source is considered, dilute or concentrated reactor, steady state or pulsed reactor, and homogeneous or heterogeneous reactor are each discussed in the light of the experimental facilities required. The core, the reflector, the pool, and the containment of the reactor and the "cold" and "hot" neutron sources and neutron guides are described. (UK)

58359 FURNACE FOR USE IN A MATERIALS TESTING REACTOR AT TEMPERATURES UP TO 2000°C. Findlay, J. R.; Mitchell, E. J.; Waterman, M. J. (Atomic Energy Research Establishment, Harwell, Eng.). J. Inst. Nucl. Eng.; 13: No. 2, 51-6(Mar-Apr 1972).

A beryllia-insulated, tungsten-wound furnace was operated successfully at temperatures up to 2000°C in a materials-testing reactor. The principles of operation and development are described. Laboratory prototype furnaces were built and were used for testing the life and compatibility of their components. (auth)

58360 TWO-DIMENSIONAL TRANSPORT EQUATIONS FOR THE DETERMINATION OF BURNUP-DEPENDENT MICRO FLUX DENSITY DISTRIBUTIONS IN MTR FUEL ELEMENTS. Krueger, A.; Mueller, A. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Atomkernenergie; 19: No. 4, 333-4(Jul 1972). (In German).

Reported are computations of microflux density distribution and micropower distribution in a fuel element segment (fuel element plate and water layer) as a function of burnup. The computations are compared with previous experiments determining the microflux density distribution parallel to the fuel element plate direction. The transport computation was performed for four energy groups. Linear anisotropy of scattering was taken into account. Burnup in the fuel matrix was computed under the assumption of a constant fuel plate power of 1.976 kW. Average computer time for each burnup step (transport and burnup) amounted to about 25 minutes. Results are presented in four graphs. (H.B.G.)

58361 STANDARD FOR THE DEVELOPMENT OF TECHNICAL SPECIFICATIONS FOR RESEARCH REACTORS. ANS-15.1 1972. Hinsdale, Ill.; American Nuclear Society (1972). 25p.

58362 HIGH FLUX FRANCO-GERMAN REACTOR. NEUTRON AND THERMAL CONSIDERATIONS. FUEL ELEMENTS. Bregeon, L. (CEN de Saclay, Gif-sur-Yvette, France); Schwartz, J. P.; Lafaurie, F. Bull. Inform. Sci. Tech. (Paris); No. 165, 27-38(Dec 1971). (In French).

The special characteristics of the High Flux Reactor (core-source, heavy water reflector, Al fuel elements, central hole with a single control rod, heavy water coolant) are examined. The core designed from fuel elements of the HFIR type consists of three coaxial zones: A central Ni control rod; 280 fuel plates assembled on two skirts by electron welding; and 5 AgInCd safety rods. Flux distribution curves in the median plane of the reactor, the reactivity of the shim rod, and the evolution of the reactivity are presented as measures of the performance obtained. (France)

58363 HIGH FLUX FRANCO-GERMAN REACTOR. THE PILE BLOCK OF THE HIGH FLUX REACTOR. Colzy, D.; Dupuy, G.; Martin, J. P. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 165, 39-55(Dec 1971). (In French).

A description is given of the assembly constituted by the fuel elements, the reflecting tank containing heavy water, the channels leading to the fuel elements, and the integrated sources. The assembly is situated in a demineralized light water thermal protection forming a swimming pool which is cylindrical having a diameter of 6 m and a depth of 14.5 m. This pool rests on the ground and is centrally situated in a double containment vessel having a diameter of 60 m and a height of 30 m. All the experimental channels guide the neutron beams across this pool, certain channels extending beyond the containment vessels. The value of the mechanical and thermal stresses in the reflector tank in the experimental channels are given for certain essential parts under overload conditions. Control and safety mechanisms are briefly described together with swimming pool arrangements. (France)

58364 HIGH FLUX FRANCO-GERMAN REACTOR. REACTOR CONTROL. Debru, M. (Institut Max von Laue-Paul Langevin, Grenoble, France). Bull. Inform. Sci. Tech. (Paris); No. 165, 71-6(Dec 1971). (In French).

In the nominal region, a thermal margin of 1.6 is envisaged between operational conditions and the onset of dangerous phenomena (flow redistribution). A control system was, however, developed enabling operation with a 1.25 margin. The detectors can only be implanted at the exit of the pile-block and consequently only the mean temperature can be determined. In order to control the reactivity, a control rod is used which moves along the axis of the fuel element; this rod weighs 15000 millimile. The residual reactivity is controlled by a burnable poison (^{10}B). In principle, the control of the HFR is centralized, although, a certain degree of decentralization is envisaged under particular conditions, an example being found in the radioprotection aspects: all the control channels which are not envisaged for automatic and safety control are decentralized. (France)

58365 DETERMINATION OF THERMAL NEUTRON ENERGY SPECTRUM BY ACTIVATION FOILS FOR A POOL TYPE REACTOR. Weng, Pao-shan; Yang, Hung-jen (National Tsing Hua Univ., Hsinchu, Taiwan). Atomkernenergie; 19: No. 4, 291-4(Jul 1972).

A set of activation foils containing ^{164}Dy, ^{176}Lu, ^{151}Eu, ^{55}Mn, and ^{115}In was used to determine thermal neutron energy spectrum in the core center of THOR fueled with 3 kg of 93% enriched uranium. An analytical form of spectrum was presumed and the parameters involved were determined by a least square fit of activation data obtained through foil irradiation with necessary correction factors being taken into account. Both the magnitude of the spectrum and its energy distribution can be obtained by this method. (auth)

58366 KEMA SUSPENSION TEST REACTOR (K.S.T.R.). Wolf, H. (NV KEMA, Arnhem, Netherlands). Polytech. Tijdschr., Elektrotech./Electron.; 27: No. 10, 312-24(10 Mar 1972). (In Dutch).

A description is given of a suspension test reactor developed by KEMA, which is based on UO_2-ThO_2 in the form of round particles approximately 5 μm in diameter, suspended in water. Design, operation, and economic advantages of the suspension reactor are given. (auth) (Netherlands)

Production Reactors

Refer also to abstract 58079.

58367 (DP-MS-72-30) PREDICTING PRODUCTION RATES OF HEAVY ACTINIDES. Graves, W. E.; Benjamin, R. W. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). [nd]. Contract AT(07-2)-1. 12p. (CONF-720901-9). Dep. NTIS.

From Meeting on new developments in reactor physics and shielding calculations; Kiamesha Lake, NY. (12 Sep 1972).

Calculation of neutron cross section data applicable to Savannah River Reactors is discussed briefly. Measurements are described, but data are not given. Production rates of Cm and Cf are given, both measured and calculated. 21 references. (J.M.J.)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 56578–56581, 56583–56590, 56594, 56595, 56615, 56619, 56654, 56683–56685, 56690, 56766, and 58391.

58368 (EURFNR-968) FUEL ROD MODEL THEORY. Models and Material Data. Kaempf, H.; Elbel, H.; Kummerer, K. (comps.) (Kernforschungszentrum, Karlsruhe (West Germany).

Institut fuer Material und Festkoerperforschung). Translation of report KFK-1400. 382p. (EUR-4577). Dep. NTIS.

Work performed under United States-Euratom Fast Reactor Exchange Program.

Separate abstracts are included for each of the 32 papers presented on fuel rod model theory and properties of reactor materials. (D.C.C.)

For abstracts of individual papers see: 56583—56591, 56641, 56642, 56736—56739, 58054—58058, and 58369—58380.

58369 (EURFNR-968, pp 5-8) CHARACTERIZATION OF FUEL ROD MODEL THEORY. Kaempf, H.; Kummerer, K.

A modeling treatment of the fuel rod design and performance involves a large number of parameters which have a complex influence on the fuel rod characteristics. To classify these parameters they are divided into the following four groups: fuel rod parameters; operating conditions; material phenomena of fuel and can; and stresses. The applications of the rod model theory are described. (D.C.C.)

58370 (EURFNR-968, pp 9-14) COMPUTER PROGRAM SATURN 0. Kaempf, H.

The SATURN 0 computer program calculates the maximum lifetimes of a fuel rod as a function of the axial position within the core. The program analyzes the maximum burnup and the radial temperature distribution. (D.C.C.)

58371 (EURFNR-968, pp 28-33) COMPUTER PROGRAM FIGRO. Depisch, F.; Elbel, H.

The computer program FIGRO was developed for the analysis of fuel swelling and radial temperature distributions in cylindrical oxide fuel rods. The fuel can be in the form of hollow or solid pellets. The program is written in FORTRAN 4. (D.C.C.)

58372 (EURFNR-968, pp 34-9) COMPUTER PROGRAM COMETHE II C. Godesar, R.

The COMETHE 2C computer program calculates the burnup characteristics of metal clad oxide fuel rods. 5 references. (D.C.C.)

58373 (EURFNR-968, pp 40-51) COMPUTER PROGRAM SATURN 1. Kaempf, H.

The SATURN 1 computer program analyzes the burnup characteristics of fuel rods. Flow diagrams for the program are presented. Input and output data are described. 4 references. (D.C.C.)

58374 (EURFNR-968, pp 58-66) COMPUTER PROGRAM CYGRO II. Kaempf, H.

The CYGRO 2 computer program calculates the mechanical and thermal behavior of fuel rods as a function of time with the external conditions such as can outer temperature, rod power, coolant pressure and gas pressure in the rod being introduced as time variables. 3 references. (D.C.C.)

58375 (EURFNR-968, pp 67-73) COMPUTER PROGRAM CYGRO III. Depisch, F.

The CYGRO 3 computer program is an extension of the CYGRO 2 program to include the cracking behavior of the fuel, migration of porosity in the fuel, and friction between the fuel column and the cladding. 3 references. (D.C.C.)

58376 (EURFNR-968, pp 81-7) COMPUTER PROGRAM SPAR. Lassmann, K.

The computer program SPAR calculates the stress and strain distributions in a fuel can. The theory involved in the program is analyzed. Applications of the program are discussed. 4 references. (D.C.C.)

58377 (EURFNR-968, pp 88-101) CREEP BUCKLING BEHAVIOR OF FUEL CANS UNDER EXTERNAL PRESSURE. Lassmann, K.

The concept of the creep buckling behavior of fuel cans under external pressure comes under the heading of stability problems, or more particularly creep stability. The analysis of the creep instability of a can under constant external pressure is based on the assumption that deviations from the ideal circular geometry are always present for reasons connected with fabrication. As a result the cross-section is subjected to bending moments which increase the curvature by means of creep processes and hence cause the bending moments to increase. 22 references. (D.C.C.)

58378 (EURFNR-968, pp 102-8) COMPUTER PROGRAMS FOR CALCULATING THE TEMPERATURE DISTRIBUTION AND FUEL COMPACTION. Caligara, F.

The computer program E2BST is used for calculating the radial temperature and porosity distributions in fuel rods. The computer program E3BST calculates changes in density over the fuel rod cross-section at the beginning of the in-reactor life. It is assumed that the compaction takes place as a result of migration of the fabrication pores against the temperature gradient. 3 references. (D.C.C.)

58379 (EURFNR-968, pp 109-14) COMPUTER PROGRAM BEMOD. Elbel, H.

The computer program BEMOD is designed for examining the behavior of a metallic fuel rod during irradiation and for obtaining a statement on the lifetime of this rod. The program calculates the stresses and strains in the can in addition to the temperature distribution in the fuel, the pressure in the gas plenum, the pressure between the fuel and the can under direct contact and the plastic deformation of the can. The parameters given in the computer time interval are the average rod power, the coolant inlet temperature, the temperature increase in the coolant along the rod and the outer pressure. The calculations are completed when the canning reaches maximum strain or undergoes damage. (auth)

58380 (EURFNR-968, pp 201-9) GEOMETRIC DESCRIPTION OF THE SURFACE PROFILES AND MODELS FOR THE HEAT TRANSFER THROUGH THE FUEL/CAN CONTACT. Godesar, R.

The surface profiles can be regarded as a series of superimposed undulations, i.e., long-waved discontinuities, roughnesses, and relatively short-waved discontinuities. Discontinuities with wave lengths greater than 0.76 mm = 3/100 in. are regarded as undulations. The two components are separated by means of the wave filter or cut-off. The measuring techniques and apparatus are described. The roughness remaining after filtration with a cut-off is described. Models for analyzing heat transfer across fuel-can surfaces are presented. 8 references. (auth)

58381 ENERGY OPTIMAL XENON SHUTDOWN. Salo, S. (Helsinki Univ. of Tech., Otaniemi, Finland). Ann. Acad. Sci. Fenn., Ser. A VI; No. 382, 1-9(1972).

The xenon shutdown problem has been solved using different kinds of performance criteria. One of the most useful perhaps is the flux time, or nuclear energy, expended. It has been shown that the solution to the restricted energy optimal problem consists of a zero power period until the boundary of restraint and a period along this boundary is switched on. It is shown, however, that the first possibility is optimal and that the second is against the maximum principle. The solution to the energy optimum shutdown problem of boron controlled reactors is also given. For a large part of the initial state space the solution is similar to the one for rod controlled reactors. The optimum trajectory for these initial states starts along a max-min-curve, arrives at the xenon boundary, and follows it to the target surface. In addition, there is an initial state region from which the optimum trajectory starts along a max-min-curve and follows it to the target curve. (auth)

58382 EMPIRICAL EXPRESSIONS RELATING THE DEPLETION AND THE ISOTOPIC COMPOSITION OF SPENT HIGHLY ENRICHED URANIUM FUEL. Moeken, H. H. Ph. (Eurochemic, Mol, Belgium). J. Nucl. Energy; 26: No. 2, 105-7(Feb 1972).

The irradiation of highly enriched uranium in a reactor is reflected in changes of the weight fractions of the uranium isotopes and in the ratios of the initial and post-irradiation amounts of uranium and its isotopes. The weight fraction of ^{235}U in uranium (w_5), the ^{236}U weight fraction (w_6), the ratio w_6/w_5, the ^{235}U weight ratio (U_5^0/U_5) and the ^{235}U weight fraction ratio (w_5^0/w_5) may be considered as irradiation parameters. The irradiation of fuel batches in one reactor core will vary over a limited range and within this range, sets of values of two irradiation parameters, measured after dissolution, may be related by simple linear expressions. It was recognized that expressions of this kind might be used by reactor operators, reprocessors and safeguards inspectors to verify the consistency of measurements on these batches and to predict post-irradiation data if sufficient experimental evidence was collected. The measurements obtained during reprocessing of many fuel batches, exposed in different reactors, were analysed to derive such expressions; relationships for verification are described. (auth)

58383 FUEL ELEMENT FOR A NUCLEAR REACTOR. de Contenson, Ghislain; Delafosse, Jacques (to Commissariat a l'Energie Atomique). French Patent 2,077,875. 5 Nov 1971. Filed 20 Feb 1970. (In French).

A fuel element is designed for use in the upright position under power and temperature conditions such that the fuel material contained in the elongated cladding is brought to its melting point in the central part. The fuel material is cut up into portions which are small compared to the length of the fuel element. These portions are separated by disks of a nonfissile material having a thermal conductivity significantly greater than that of the fuel material. The disk and fuel materials are compatible, the disk being in good thermal contact with the cladding and the portions of the fuel elements. The separating disks are irregularly placed along the element, the greatest number being provided at positions receiving the greatest amount of neutron flux during reactor operation. In order to reduce the temperature of the core of the fuel elements, these disks may have a convex or planoconvex form, or a concave or planoconcave form, holes being provided for the passage of fission gases. The fuel material consists of sintered pellets of uranium or plutonium dioxide or a ground fuel oxide compacted by vibrations in the cladding. (France)

58384 FUNDAMENTALS OF THE PNEUMATIC TRANSPORT OF SPHERICAL FUEL ELEMENTS. Faber, R.; Mauersberger, R.; Rysy, W. (Hochtemperatur-Reaktorbau GmbH, Cologne). Kerntechnik; 14: No. 4, 153-7(Apr 1972). (In German and English).

Starting from the theorem of momentum conservation, an equation is derived for the gas velocity required to hold a sphere in suspension in a vertical or an inclined tube. Comparisons with experimental results obtained with a tube diameter of 65 mm show that, for spheres with a diameter greater than 20 mm, the experimentally determined gas velocities required are lower than the theoretically calculated values, but only by up to 10% at most. In addition to graphs of gas velocities, graphs of drag coefficients of spheres in tubes are also shown. (auth)

Reactor Physics and Core Engineering

58385 CALCULATION OF AMPLITUDE IN ROSSI-α EXPERIMENT. Rypar, Vojtech (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 18: No. 5, 166-7(May 1972).

For multichannel time-analyzer measurements, $\Pi_2(t) = C\ (1 + K \exp(-\alpha t))$. An integral form is given for the correlation amplitude K, which can be calculated using a digital computer. The integral is evaluated as a sum of three hypergeometric series. The shape of the exponential term amplitude CK is discussed. The optimum reactivity values from the viewpoint of accuracy are about $2 in some cases. (D.L.C.)

58386 REACTIVITY MEASUREMENTS BY ROD DROP METHOD WITH REAL MOVEMENT OF ABSORBER TAKEN INTO ACCOUNT. Bouzyk, J.; Chwaszczewski, S.; Jablonski, J. (Inst. of Nuclear Research, Swierk, Poland). This paper was summarized in At. Energ. (USSR); 30: No. 4, 381(Apr 1971) as paper No. 473/5865. (In Russian).

Full copy of this paper is held by TIC.

An equation is derived for refining reactivity measurements by the rod drop method: $\rho_0 = \{\Theta(0)[\Lambda^* + \bar{\lambda}^{-1}]/\int_0^\infty \rho'(t)\Theta(t)dt\}$. The proposed reactivity measurement method was verified experimentally on the Anna critical assembly. The absorber was located by measuring potentiometer voltages and by the number of pulses generated as the absorber is moved. Results confirm the feasibility of utilizing an analog computer system in reactivity measurements. (D.L.C.)

Physics

Refer also to abstracts 56193, 56236, and 57539.

58387 (IAEA-TA-541) NEUTRON FLUX MEASUREMENT. Report to the Government of Korea. Navalkar, P. M. (International Atomic Energy Agency, Vienna (Austria)). May 1970. 5p. INIS.

Following a request from the Republic of Korea to IAEA for the services of an expert in the field of neutron flux measurements, the author was assigned to the Atomic Energy Research Institute, Seoul, in July 1969 for a period of six months. A description of the present status of the Reactor Engineering Division (Korean Atomic Energy Research Institute) is given and recommendations are made with regard to its future activities. Some neutron flux measurements performed with the participation of the author are listed. (GF)

58388 (INIS-mf-206) EXPERIMENTAL STUDIES OF EFFECTIVE CROSS SECTIONS, REACTION RATE DISTRIBUTIONS, AND NEUTRON SPECTRA IN SOME FAST REACTOR CORES. Andersson, Tor Leif (Lund Univ. (Sweden)). 1971. 18p. INIS.

Four types of measurements at the fast critical facility FRO are described: (1) Reaction rate ratios and distributions were measured in different cores with miniature fission counters and with foil activation technique. The five structures in spatial neutron flux distribution due to core heterogeneity were studied and compared with calculations. The heterogeneity effect was in several cores greatly reduced by the use of very thin plates of the core constituent materials. (2) Spectrum measurements with resonance sandwich detectors were performed in three FRO cores with relatively soft spectra. The ^{197}Au, ^{186}W, ^{55}Mn, and ^{23}Na resonances were utilized and the counters were calibrated in a well-known epithermal spectrum in the thermal reactor R1. Comparison with calculations gave good agreement for two uranium cores while the calculated spectrum for a plutonium core was found to be too hard. (3) The capture-to-fission ratio for ^{239}Pu and ^{235}U was measured by an integral method. The reactivities of small samples of the fissile iostopes and a boron standard are measured together with the absolute fission rates and the reaction rate, respectively. The measurements made in two rather soft spectra support rather high α values and are obtained with experimental uncertainties between 1.5 and 4.5 per cent. Calculated values lie within the experimental uncertainties. (4) The reactivity worths of 10 main fission products and a fission product mock-up sample were determined by the pile-oscillator technique in three fast reactor spectra. Corresponding calculated values are generally found to be higher. (Sweden)

58389 (ORNL-TM-3975) FAST REACTOR SHIELDING MONTHLY PROGRESS REPORT FOR JULY 1972. 189a No. 10028, Activity No. 40 01 61. Mynatt, F. R.; Stevens, P. N.; Gritzner, M. L.; Maerker, R. E.; McGregor, B. J. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 30p. Dep. NTIS.

The progress made by the ORNL Neutron Physics Division in Fast Reactor Shielding Research during the month of July 1972 is summarized. (auth)

58390 NEUTRON KINETICS OPTIMIZATION IN THE ZERO REACTIVITY METHOD APPLIED IN A COUPLED GRAPHITE–D_2O REACTOR. Giacobbi, V. (CNEN, Bologna); Rustichelli, F. Nucl. Instrum. Methods; 103: No. 3, 581-6(1972).

An analysis of neutron kinetics is performed in the experimental determination of the infinite multiplication factor K_∞ of D_2O lattices by the zero reactivity method. Investigations of the experimental conditions which minimize the uncertainty in the value of K_∞ are carried out, after the basic uncertainties related to the reactivity determinations by the asymptotic period measurements have been taken into account. In particular the influence of the delayed and photoneutron general data is considered and also that of the delayed and photoneutron efficiencies in the particular reactor used in the measurements. The photoneutron efficiency in the coupled graphite-D_2O reactor involved in the reactivity determinations is estimated to be 0.5 ± 0.2 by means of a theoretical calculation and an experimental evaluation based on perturbation theory. It is shown that the relative uncertainty introduced in K_∞ by the reactivity measurements is $\sigma(K_\infty)/K_\infty \approx 10^{-5}$ at the working conditions chosen. (10 references) (auth)

58391 MULTIPLE INPUT–OUTPUT FEEDBACK SYNTHESIS INCORPORATING CROSS-COUPLING. Ferg, David Alvin. Tucson, Ariz.; Univ. of Arizona (1971). 198p. University Microfilms Order No. 71-24,884.

Thesis.

A computational procedure is formulated for the feedback synthesis of a linear multivariable control system with input, output cross-coupling. The feedback synthesis technique which is developed results in a closed-loop interacting transfer matrix containing the desired transfer functions between all permutations of the system outputs and the external control inputs. The technique depends on previously established decoupling techniques for the state-variable feedback design of noninteracting multivariable control systems. A condensed review of the literature pertaining to decoupling techniques is presented. The necessary formulation required to compute a pair of decoupling state feedback and gain matrices for a multivariable system is described. A variational decoupling technique is developed which represents a logical mathematical procedure for decoupling a given multivariable system into all possible transfer function relationships between the system outputs and the control inputs. (Diss. Abstr. Int., B)

58392 CAN ONLY PART OF A CRITICAL NUCLEAR REACTOR FORM A CRITICAL REACTOR? Bartosek, V. (Nuclear Research Inst., Rez, Czech.). Czech. J. Phys.; 21: No. 12, 1310-11(1971).

An analysis of the condition where a part of a critical reactor with nonuniformly distributed local buckling can form a critical reactor is presented. (auth)

58393 PHYSICS OF A CIRCULATING CRITICAL GAS. Deresh, Bruce Alan. Los Angeles; Univ. of California (1971). 343p. University Microfilms Order No. 72-2800.

Thesis.

A study has been conducted on the physics of a circulating critical gas which is compressible. The reactor concept consists of a constant cross-section tubular reactor core, perfectly reflected in the transverse direction, and an external circuit with heat and fission-product removal such that the gas is regenerated for each pass through the core. In addition, a converging-diverging nozzle was assumed interchangeable with the section of tube just prior to the core inlet so that supersonic flow and shock compression could be studied. Conservation equations of mass, momentum, and energy were written for the flow of fully enriched $U(235)F_6$ gas with a universal turbulent wall friction coefficient as a function of local Reynolds number. Neutronically, the reactor was modelled with the monoenergetic transport equation and a transport form of the delayed-neutron precursor balance to account for the influence of the external circuit. Thermal radiation effects are shown to be negligible for many reactor states of interest. The coupling between the gas and neutron fields is shown to be the mass density rather than the temperature. From a physical standpoint, this coupling occurs in the neutron cross-sections which are strongly influenced by the mass density. Steady-state reactor behavior was calculated by uncoupling the neutronics from the reactor hydrodynamics via certain transformations. The core neutronics was solved numerically by the least squares method of polynomial synthesis. The reactor hydrodynamics was solved by Hamming's Predictor-Corrector algorithm. Perturbations of the critical reactor were examined to determine space-time solutions and reactor stability. A direct-integration algorithm for the solution to coupled sets of integro-partial differential equations was developed for this purpose. (Diss. Abstr. Int., B)

58394 STABILITY CRITERION FOR THE KINETIC REACTOR EQUATIONS WITH LINEAR FEEDBACK. Di Pasquantonio, F. (ENEL, Milan); Kappel, F. Energ. Nucl. (Milan); 19: No. 3, 162-75(Mar 1972).

The stability criteria relating to point nuclear reactor kinetics give conditions for global asymptotic stability. These criteria are over-restrictive in reactor design, since no real reactor can be operated at very high power levels due to heat transfer limitations. Moreover for many important reactor models, criteria for global asymptotic stability cannot be applied because these models get linearly unstable at high operating power levels. A frequency domain criterion for the asymptotic stability of the power equilibrium state is given for the most general form of linear feedback and for a bounded domain of initial functions. For two important nuclear reactor models the inequalities defining domains in finite dimensional state space which are certainly contained in the domain of attraction are given in explicit form. 18 references. (auth)

58395 FOIL HANDLING TECHNIQUE FOR THE MEASUREMENT OF LATTICE PARAMETERS IN PuO_2–UO_2 FUEL RODS. Nakamura, Yasuji (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan); Miyawaki, Yoshio; Sasao, Nobuyuki; Hachiya, Yuuki; Shimamura, Akira. J. Nucl. Sci. Technol. (Tokyo); 9: No. 5, 277-80(May 1972).

A new foil handling technique using activation foil cassettes was developed for the measurement of lattice parameters in a PuO_2–UO_2 fuel rod. The cassette is constituted of activation foils enveloped in thin (0.02 mm) Al foil which prevent Pu contamination and also work as fission-product-catcher foils, without causing any additional perturbation of the measuring medium. The experimental accuracy is found to be almost the same as for UO_2 fuel rods. The technique is adapted to application in a wide survey of lattice parameters for Pu-fueled reactors. (auth)

58396 EQUIVALENT SYSTEMS OF KINETICS EQUATIONS FOR A CIRCULATING-FUEL REACTOR. Zhukov, V. P.; Kreer, R. I. This paper was summarized in At. Energ. (USSR); 31: No. 2, 134(Aug 1971) as paper No. 511/6200. (In Russian).

Full copy of this paper is held by TIC.

Mathematical descriptions of neutron-kinetics processes in circulating-fuel reactors are discussed in which equivalent equations using only one group of delayed neutrons are utilized. The "point" model of a circulating-fuel reactor was used. Two equivalent parameters are determined: the decay constant λ and the separation factor α of the equivalent group of sources of delayed neutrons. Criteria for determining λ and α are studied; best results are obtained with the criterion for approximation of $d^2\nu/dt^2|_{t=0}$, $d\nu_{lin}/dt|_{t\to\infty}$. (D.L.C.)

58397 DYNAMICS OF NEUTRON KINETICS PROCESSES IN A CIRCULATING-FUEL REACTOR. Zhukov, V. P.; Kreer, R. I. This paper was summarized in At. Energ. (USSR); 31: No. 2, 134(Aug 1971) as paper No. 510/6199. (In Russian).

Full copy of this paper is held by TIC.

A simplified ("point") model of neutron kinetics was derived using the assumption that the time for the fuel to pass through the core is much shorter than the average lifetime of the principal sources of delayed neutrons. Equations were derived which were used in an analog computer simulation of the dynamic properties of circulating-fuel reactors. The principal perturbation in various modes of perturbation was found to be the reactivity perturbation. The effects of delayed time and of the degree of separation of the delayed-neutron sources were investigated; separation of sources of delayed neutrons having the highest $\beta_i\lambda_i$ value was found to exert the greatest influence. (D.L.C.)

58398 USE OF NUCLEAR REACTORS AS THERMAL RADIATION SOURCES. Almenas, K. (Univ. of Maryland, College Park). pp 29-35 of 1971 Intersociety Energy Conversion Engineering Conference. New York; Society of Automotive Engineers, Inc. (1971).

From sixth intersociety energy conversion engineering conference; Boston, MA. (3 Aug 1971). See CONF-710803.

The feasibility of using a nuclear reactor as a thermally radiating energy source is investigated. Design limits arising from radiant energy transmission, criticality and heat-transfer problems are evaluated. The wide uncertainty margins in extremely high temperature data properties are bracketed by extending the study to cover the whole feasible parameter range. It is concluded that from the heat transfer and criticality point of view several types of spherical shell reactors can be operated at surface temperatures of 2800°K. 12 references. (auth)

Core Thermal Hydraulics

58399 (INIS-mf-196) RESEARCH AND DEVELOPMENT IN HEAT TRANSFER. Smedley, H. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). 1971. 7p. (CONF-710317-7). INIS.

From 16th nuclear congress; Rome, Italy (25 Mar 1971).

Research and development work in heat transfer at AECL has been centered mainly on cluster fuel operating within a CANDU-type pressure tube. The heat transfer capability of the Gentilly CANDU-BLW fuel was estimated from out-pile tests at Columbia University, Winfrith, and Canadian Westinghouse and in-pile tests done in the NRU U1 loop at Chalk River Nuclear Laboratories (CRNL). None of these tests could duplicate a full-scale channel operating at reactor conditions and this lengthened the development program and increased the analytical work. A faster and more direct approach will be possible in a 1.2-MW Freon loop to be completed this year at CRNL. A compensated distortion model has been developed to predict fuel bundle performance in water measurements in Freon with an acceptably small error. Before starting a test program on a new fuel, several potentially suitable designs are subjected to a comprehensive computer analysis which takes into account burnup, fabrication cost, and other factors in addition to heat transfer. The estimates of heat transfer performance for such an analysis are derived from consideration of subchannel enthalpy rise. The technique used takes into account bundle dimensions. The heat transfer research done in AECL laboratories is augmented by industrial and university contracts which make up about half the total effort. (Canada)

58400 (KFK-EXT-4/71-29) PRESSURE DROP AND HEAT TRANSFER AT SMOOTH AND ROUGH SURFACES UNDER HIGH TEMPERATURES AND TURBULENT STREAMS AND ITS DESCRIPTION BY UNIVERSAL RULES. Meerwald, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). May 1971. 64p. (In German). INIS.

In fast reactor cores, very high power densities are present. It is therefore necessary to improve the heat transfer from the fuel elements to the coolant. Experiments were performed with 15 different electrically heated rough rods at surface temperatures up to 1200°C, contained in concentric smooth tubes. Heat transfer and friction correlations are developed for turbulent flow in annulus having a repeated-rib roughness. The friction correlation is based on the law of the wall similarity. The heat transfer correlation is based on the application of a heat-momentum transfer analogy to flow over a rough surface, which was first used by Dipprey and Sabersky for sand-grain roughness. The friction correlating parameter and the heat-momentum analogy correlation is compared with other roughnesses to be found in the literature. (auth) (GF)

58401 (N-70-42233) FLOW EXCURSIONS IN A SIMULATED GAS-COOLED-REACTOR PASSAGE. Vingerhoet, Paul; Reshotko, Eli (Case Western Reserve Univ., Cleveland, Ohio. School of Engineering). Sep 1968. 64p. (NASA-CR-110777; FTAS/TR-68-34). NTIS.

The characteristics of flow excursions believed to result from laminar instability are discussed. The steady-state characteristics of helium gas flowing in an electrically heated ID 0.094 in. Nichrome 5.54 in. tube were observed and recorded. Constant pressure-drop excursions were also triggered and observed; their histories are presented. The results tend to substantiate Reshotko's theory that a nonoscillatory and nonviolet excursion has a characteristic time proportional to the heat capacity of the tube, namely of the order of seconds to minutes. (auth) (STAR)

58402 HEAT SOURCE FUNCTION, DISTRIBUTION OF HEAT FLUX DENSITY, AND TEMPERATURE-FIELD AT A REACTOR FUEL UNIT MODEL IN THE CASE OF A HEAT AND ELECTRIC CONDUCTIVITY DEPENDING ON THE TEMPERATURE. Toth, Ivan; Toeroek, Attila. Energ. Atomtech.; 24: No. 8, 335-41(Aug 1971). (In Hungarian).

In reactor subchannel thermohydraulic experiments mostly electrically heated stainless steel tubes are used. Since thermal and electric conductivity of the tube material are temperature-dependent and the temperature field is space dependent, the volumetric heat generation rate and the surface heat flux will be a function of space too. To allow a correct evaluation of experimental results, the present paper determines these functions, for the case of temperature dependent parameters. (auth)

58403 EXPERIMENTS ON TEMPERATURE AND FLOW VELOCITY FLUCTUATION OF COOLANT AND THE POSSIBILITY OF DETERMINATION OF NOISE SOURCE. Oka, Yoshiaki; Kondo, Shunsuke; An, Shigehiro (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 6, 330-8(Jun 1972).

Experiments on temperature and velocity fluctuations were conducted with an out-of-pile heat transfer loop. A number of experimental results are presented, such as the dependence of coolant temperature fluctuations on flow rate and heat flux, as also the power spectral density of temperature and flow velocity fluctuations. The dependence relations make it possible to detect flow channel blockage and coolant boiling by measuring coolant temperature fluctuations. To measure directly the velocity fluctuations in water flow, a newly developed device named "cell flowmeter" was used. A formulation of power reactor noise is presented to examine the noise spectrum distortion in the low-frequency region by Langvin's method. One of the conclusions is that it will be possible to determine the dominant noise source in a power reactor by observing the reactor power and coolant flow rate dependence of the "magnitude" of neutron noise spectrum, or the dependence of the amplitude of neutron fluctuations on the reactor power and coolant flow rate. (auth)

58404 ATLAS: THERMAL-HYDRAULIC FUEL TEST FACILITY. Matzner, B.; Schraub, F. A. (General Electric Co., San Jose, Calif.). Nucl. Eng. Int.; 17: No. 194, 556-9 (Jul 1972).

Details are given of the 8.6-MW heat-transfer facility ATLAS, which is designed to improve the thermal hydraulic performance of the boiling-water-reactor core, by investigating flow and enthalpy distribution of full-scale BWR bundles. The facility has the full range of steady-state testing capabilities and numerous transient capabilities especially designed into it. It includes high-speed loop instrumentation and data acquisition equipment. Adjacent to the loop is an area for fabrication of electrically heated rod bundles, the testing of which is described. (UK)

GENERAL

Civilian Defense

Refer also to abstract 56454.

58405 (COO–38-621(Rev.2)) THESAURUS FOR RADIATION CHEMISTRY. (Notre Dame Univ., Ind. Radiation Lab.). Aug 1972. Contract AT(11-1)-38. 77p. Dep. NTIS.

58406 (TID–4552(Rev.8)) SUBJECT SCOPE OF NUCLEAR SCIENCE ABSTRACTS. Volume 26, Number 1: Abstracts 1–1769. (Technical Information Center (AEC), Oak Ridge, Tenn.). Jan 1972. 71p.

The subject scope and arrangement of literature in Nuclear Science Abstracts (NSA) are defined. The major fields of nuclear science and technology into which NSA is divided are identified, and the extent of interest in the chemical elements is defined. (W.H.K.)

Law

58407 (AECL–4211) SEMINAR FOR LABOUR ON THE OBJECTIVES AND WORK OF CRNL, MAY 29, 30, 31, 1972. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). 1972. 50p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

Nine general papers were presented, with the object of placing in perspective the work and contributions of the various unions at the Chalk River Nuclear Labs. These were: ‘‘Canada’s nuclear power program in context with that of the world’’ (also published as AECL-4254) (A. J. Mooradian); ‘‘Human resources at CRNL’’ (J. H. Collins); ‘‘Replacement of the NRX reactor vessel, 1970’’ (D. G. Breckon); ‘‘CRNL—a safe place to work’’ (L. C. Watson); ‘‘Engineering support for power reactors’’ (A. E. Hart); ‘‘Future trends in labour relations’’ (W. Dodge); ‘‘Atomic energy, public safety, and environmental protection’’ (I. L. Ophel); ‘‘Heavy-water—the fluid drive for Canada’s power reactors’’ (H. K. Rae); and ‘‘Some why’s and wherefore’s of accelerator technology at CRNL’’ (P. R. Tunnicliffe). (Canada)

58408 ACTION ON REACTOR AND OTHER PROJECTS UNDERGOING REGULATORY REVIEW OR CONSIDERATION. Blakely, Paul. Nucl. Safety; 13: No. 5, 422-37(1972).

The in-process license application records of various power reactors and fuel processing facilities are reported. Data for power reactors and processing facilities for which operating licenses have already been issued are given. Recent regulatory and other actions relating to certain reactors and projects are summarized as of June 1, 1972. (M.C.G.)

58409 SUMMARY OF LEGISLATIVE AND REGULATORY ACTIVITIES AFFECTING THE ENVIRONMENTAL QUALITY OF NUCLEAR FACILITIES. Bryan, R. H.; Nichols, B. L. Nucl. Safety; 13: No. 5, 441-7(1972).

State water quality criteria are presented. They were compiled from standards adopted by responsible state agencies, interstate bodies, and/or the Environmental Protection Agency. The use classification system was used to summarize and tabulate the data. (M.C.G.)

58410 ACCESS OF CIVIL NUCLEAR POWERED SHIPS TO TERRITORIAL WATERS AND FOREIGN PORTS. Albano, Raffaele. Bull. Droit Nucl.; No. 9, 56-62(Apr 1972). (In French).

The access of nuclear propulsion ships to territorial waters and foreign ports is subject to the rules laid down by the London Convention of June 17, 1960, and the Brussels Convention of May 25, 1962 (not yet put into operation). In accordance with the London Convention, this access must coincide with a prior authorization from the state through whose waters the ship will pass, this state having the right to choose, at its own convenience, the unloading port. Article 14 of the 1958 Geneva Convention recognizes the right of a ship to cross territorial waters inoffensively (i.e., in a manner that does not prejudice the state or endanger its security). The practice of bilateral agreements emphasizes the complex legal problems concerning responsibility. The ENEA (OECD) has undertaken detailed studies with a view toward eliminating the present difficulties. (France)

Miscellaneous

Refer also to abstracts 56292, 56329, 56421, and 58011.

58411 (AEC-tr–7317) SUMMARY OF FRENCH FIRST AID PRACTICES, PROTECTIVE CLOTHING, AND EXTINGUISHMENT TECHNIQUES FOR SODIUM OR NaK. Translation of French Safety Regulations. 5p. Dep. NTIS.

58412 (AI-AEC-Memo–12880) APPROXIMATE SOLUTION TO THE GENERAL EQUATION FOR THE COAGULATION OF HETEROGENEOUS AEROSOLS. Hubner, R. S. (Atomics International, Canoga Park, Calif.). 26 Sep 1969. 126p. Dep. NTIS.

58413 (BARC–609) MULTIPLE THIN FILM VAPOUR DEPOSITION UNIT. Agarwala, R. P.; Due, A. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 11p. Dep. NTIS (U. S. Sales Only).

58414 (BARC–610) IMAGE TUBE ASSESSMENT. Katti, V. R.; Rangarajan, L. M.; Bhide, G. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 39p. Dep. NTIS (U. S. Sales Only).

58415 (BDX–613-676(Rev.)) SEMI-RIGID COAXIAL CVR/CABLE, FY72–3. Quarterly Report. Almquist, K. D. (Bendix Corp., Kansas City, Mo.). Sep 1972. Contract AT(29-1)-613. 28p. Dep. NTIS.

58416 (BNL–17120) MULTIPHONON AND SINGLE-PARTICLE EXCITATIONS IN QUANTUM CRYSTALS. Horner, Heinz (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Aug 1972. 8p. (CONF-720833–16). Dep. NTIS.

From thirteenth international conference on low temperature physics; Boulder, CO. (20 Aug 1972).

58417 (BNL–17187) DETERMINATION OF RESONANT VIBRATION FREQUENCY OF CONCRETE BY AN ACOUSTIC IMPACT TECHNIQUE. Wang, James C. K.; Auskern, Allan; Horn, William (Brookhaven National Lab., Upton, N. Y.). Sep 1972. 16p. Dep. NTIS.

58418 (COO–873-37) STUDY OF PLANT VIRUS REPLICATION. Technical [Progress] Report, December 1, 1971–November 30, 1972. (Arizona Univ., Tucson). 1972. Contract AT-(11-1)-873. 9p. Dep. NTIS.

58419 (COO–1041-24) IMPURITY DIFFUSION IN SOLIDS. Technical Progress Report, December 1, 1971–November 30, 1972. Tomizuka, C. T. (Arizona Univ., Tucson. Dept. of Physics). 1972. Contract AT(11-1)-1041. 6p. Dep. NTIS.

58420 (COO–1198-911) MICTOMAGNETISM IN ALLOYS. Beck, Paul A. (Illinois Univ., Urbana). [nd]. 18p. Dep. NTIS.

58421 (COO–1436-35) TRANSPORT AND THERMODYNAMIC PROPERTIES OF SOLIDS. Technical Progress Report, September 1, 1971–August 31, 1972. Grace, Richard E. (Purdue Univ., Lafayette, Ind. School of Materials Science and Metallurgical Engineering). 1 Sep 1972. Contract AT(11-1)-1436. 36p. Dep. NTIS.

58422 (COO–1599-48) DECOMPOSITION OF DISSOLVED ORGANIC CARBON AND NITROGEN COMPOUNDS FROM LEAVES IN AN EXPERIMENTAL HARDWATER STREAM. Wetzel, R. G.; Manny, B. A. (Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station). 1972. 14p. Dep. NTIS.

58423 (COO–3140-1) TOXICOLOGY AND METABOLISM OF NICKEL COMPOUNDS. Progress Report, December 1, 1971–November 30, 1972. Sunderman, F. William (Connecticut Univ., Farmington (USA). School of Medicine). 1972. Contract AT-(11-1)-3140. 266p. Dep. NTIS.

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58428 (COO–3521-1) BIOLOGICAL RESEARCH ON THE VOLCANIC ISLAND SURTSEY AND ENVIRONMENT FOR THE YEAR 1971. Technical Progress Report. Fridriksson, Sturla (Surtsey Research Society, Reykjavik (Iceland)). 1971. Contract AT(11-1)-3521. 89p. Dep. NTIS.

58429 (COO–3565-1) MARINE MICROBIOLOGY. Five-Year Progress Report, 1967–1972. Watson, Stanley W. (Woods Hole Oceanographic Institution, Mass.). 1972. Contract AT-(11-1)-3565. 62p. Dep. NTIS.

58430 (GAT-Z–4128(Vol.1)) EXPERIMENTAL INVESTIGATION OF AIR RECIRCULATION CHARACTERISTICS OF AIR COOLED CONDENSER ARRAYS ON A PROCESS BUILDING. Report EERL-TR–105. Hoydysh, W. G.; Strom, G. H.; Cirillo, R. R. (New York Univ., N. Y. (USA). Dept. of Aeronautics and Astronautics). Jul 1971. Contract AT(33-2)-1. 143p. Dep. NTIS.

For Goodyear Atomic Corp., Piketon, Ohio.

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58432 (IS–2920) ABSTRACT MACHINE TO CONTROL THE EXECUTION OF SEMI-INDEPENDENT CONCURRENT COMPUTATIONS. Wallentine, V. E.; Wright, C. T. Jr.; Keller, R. F. (Ames Lab., Iowa). Sep 1972. Contract W-7405-eng-82. 100p. Dep. NTIS.

58433 (IS-T–522) SYNTHESIS AND CHARACTERIZATION OF THREE POLYHALOGEN TETRACHLOROALUMINATES. Merryman, D. J. (Ames Lab., Iowa). Aug 1972. Contract W-7405-eng-82. 72p. Dep. NTIS.

Thesis.

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58447 (ORNL-TIP/TIRC–72-58) TOXICITY OF HEXACHLOROCYCLOPENTADIENE. Oliveira, Deanna (Toxicology Information Response Center, Oak Ridge, Tenn.). Sep 1972. 3p. Dep. NTIS.

58448 (ORNL-TM–3876) MODIFICATIONS OF A NILAB DILUTER-SAMPLER USED IN THE DEVELOPMENT OF AN AUTOMATED GeMSAEC SAMPLE-REAGENT LOADER. Burtis, C. A.; Johnson, W. F.; Mailen, J. C. (Oak Ridge National Lab., Tenn.). Aug 1972. 17p. Dep. NTIS.

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Germanic	ä appears as	ae
Germanic	ö	oe
Germanic	ü	ue
Scandinavian	ϕ	oe

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SUBJECT INDEX

Cross references are included in cumulative subject indexes and in *Subject Headings Used by the USAEC Technical Information Center* (USAEC report TID-5001).

The reader is also referred to *Guide to Abstracting and Indexing for Nuclear Science Abstracts* (USAEC report TID-4576).

Most headings in the subject index are the names of specific materials, things, and processes. Each heading is followed by a modifier that describes the properties of, or processes applied to, that heading.

All index entries cite *NSA* volume and abstract numbers; volume number precedes the colon and the abstract number follows it. The designation (R) following the abstract number indicates a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Report numbers, where applicable, are included in parentheses after the abstract number of the citation. Published literature (journal article or book) can be identified by the absence of a report number.

Ideas presented in the original literature, rather than key words, have been indexed. The indexers have selected what seemed the most probable and logical place to look for typical information. Since it is not always possible to anticipate where a user would look for information, the cumulative indexes include numerous cross references. Consideration of synonymous or closely related terms will prove valuable.

Information is indexed for the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use or to the general class headings that include the specific headings. For example, information on boiler design for the Fermi Fast Breeder Reactor would be indexed under the headings BOILERS and FERMI FAST BREEDER REACTOR but not necessarily under the headings REACTORS, FAST or REACTORS, BREEDER.

General or broad headings are reserved for general summaries, reviews, comprehensive reports, and similar literature.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings; e.g., AMINO ACIDS rather than ACIDS, AMINO; HELIUM ISOTOPES He-4 rather than HELIUM—ISOTOPES He-4 or HELIUM—He-4 ISOTOPES. Note, however, that in some cases parenthetic modifying terms or inverted headings such as NEUTRONS, FAST, are used where the alphabetical arrangement of a direct entry would cause information to be scattered. In addition, organic compounds are usually entered in the index in the inverted form to facilitate grouping like or related compounds with the parent compounds; e.g., BENZENE, BROMO- rather than BROMOBENZENE.

Alphabetization

Subject headings are alphabetized word by word. Parenthetic qualifiers, numbers, and Greek letters within subject headings are disregarded in alphabetizing unless there are two or more headings that are otherwise identical, in which case the qualifier, numerical progression, or spelled names for the Greek letters determine the order.

Examples:

M-Capture
  see ELECTRON CAPTURE
MAGNESIUM
MAGNESIUM ALLOYS AND SYSTEMS
MESONS
MESONS (π)
MESONS (rho)
1-PENTANOL
2-PENTANOL
URANIUM OXIDES
URANIUM OXIDES UO$_2$

Modifying Phrases

The modifiers appearing under a subject heading are written specifically to show the relation between the item being indexed and the heading. The modifier therefore contains a maximum of useful information. Although the modifier begins with the word judged to be of greatest use to the greatest number of users, there is still need for the searcher to consider all modifiers under the heading(s) of interest.

Modifiers usually form meaningful phrases when combined with the subject heading. Some are intended to be read following the subject heading, e.g., the entry HYDROGEN—*sorption by charcoal,* should be read *hydrogen sorption by charcoal.* As a result of placing the important word first, however, many modifiers must be rearranged for smooth reading, e.g., FORMALDEHYDE—*yields in radiolysis of ethyl ether, effects of deuterium on,* should be read *effects of deuterium on formaldehyde yields in radiolysis of ethyl ether* and URANIUM—*crystal structure of, effect of cooling rate on allotropic transformations in,* should be read *effect of cooling rate on allotropic transformations in crystal structure of uranium.*

Special characters are added to modifiers in the fields of physics and reactor technology; if the modifier does not establish the experimental or theoretical character of a reference, a symbol (E), (T), or (E/T) is placed immediately after the modifying phrase and before the abstract number.

Physical States and Configurations of Materials

The specific physical state, if other than normal, or the geometric configuration of the material is included in the modifying phrase; e.g., information on liquid metals is indexed under the specific metal with "liquid" in the modifier and carbon crucibles is indexed under CARBON with "crucibles" appropriately placed in the modifier. The information on carbon crucibles is also indexed under CRUCIBLES.

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed to subject headings in the direct form. Cations are listed in the order of increasing valence for polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., SODIUM ALUMINUM SILICATES and POTASSIUM SODIUM SULFATES. If more than one anionic species is presented in a compound, the anions are arranged alphabetically, e.g., BERYLLIUM FLUORIDE HYDROXIDES.

Nomenclature of Organic Compounds

Complex organic compounds occur in such variety as to require a systematic nomenclature. Headings for most substituted organic compounds are found in an inverted form following names of the parent compounds. Examples of two such headings are:

```
2,4-HEPTANEDIONE
2,4-HEPTANEDIONE, 1-PHENYL-
```

Headings are included for broad class names of enzymes, e.g., HYDROLASES and TRANSFERASES. Specific enzyme names are to be found in modifiers under these headings. Similarly, broad class names for hormones are included as headings, except in this case the headings are entered in the inverted form as, e.g., HORMONES, ADRENAL and HORMONES, SEX. The more specific names of hormones are to be found in the modifiers under the appropriate broad headings.

For compounds used as drugs, an effort is made to use subject headings that reflect the recommendations of the USAN (United States Adopted Names) compilation or the "New Names" columns of the *Journal of the American Medical Association.* The *Merck Index* has also been used in selecting subject headings for drugs.

Nomenclature of Life Sciences

Except for those in the phylum Tracheophyta, subject headings for plants are common names. For example, ALGAE, FUNGI, SLIME MOLDS, MOSSES, and LIVERWORTS are subject headings. The phylum name TRACHEOPHYTA and several classes and subclasses belonging to it are entered as subject headings. The specific classes entered are PSILOPSIDA, LYCOPSIDA, SPHENOPSIDA, and PTEROPSIDA. The three subclasses FILICINIDAE, GYMNOSPERMIDAE, and ANGIOSPERMIDAE which belong under Pteropsida are also subject headings. Scientific names (genus and species) and common names if known are used in the modifying phrase.

Subject headings for microorganisms are VIRUSES, RICKETTSIA, and BACTERIA. The name of the type or kind of virus or the genus and species names of the organisms should appear in the modifying phrase.

The names of animal phyla are subject headings. The arthropods are also indexed to subject headings for classes INSECTA, CRUSTACEA, ARACHNIDA, DIPLOPODA, and CHILOPODA. The invertebrate chordates are indexed to subject headings UROCHORDATA and CEPHALOCHORDATA. The vertebrates are indexed to headings for the classes AGNATHA, CHONDRICHTHYES, OSTEICHTHYES, AMPHIBIA, REPTILIA, AVES, and MAMMALIA as well as to the general heading VERTEBRATA. Common names are used as subject headings in the class Mammalia.

Subject headings are entered for various classes of commodities, and specific products are identified in the file-word position of the modifier. In the following examples, approved subject headings are capitalized and typical modifier file words are listed in lower case.

Example 1	Example 2
CEREALS	MEATS
bread	beef
flour	fish
oats	mutton
rice	pork
rye	poultry
wheat	seafood

Diseases, pathological conditions, and in vitro studies of atypical cells and tissues are indexed under subject headings for the organism affected, under the appropriate anatomical structure of physiological phenomenon affected, and under the appropriate disease heading. Subject headings for diseases (defined as any deviation from the norm) are common names such as ANEMIA, FIBROSIS, INFECTIONS, LEUKEMIA, NEOPLASMS, and RADIATION SICKNESS. Also, the general headings DISEASES and DISEASES, PLANTS are available as subject headings.

Multicomponent Alloys and Other Systems

Multicomponent alloys and systems, except those with well-known trade names, are indexed under a subject heading for each component in the form "element systems" for nonmetals or "element alloys and systems" for metals. The modifier begins with element symbols for each component arranged alphabetically. In addition, if significance is placed on the base metal of the alloy, this is indicated by adding "-base" to the element symbol.

Example: A 1.5C, 12Cr, 0.25V, 0.8Mo, bal Fe alloy is indexed as

```
CARBON SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
CHROMIUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
IRON ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
MOLYBDENUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
VANADIUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
```

Well-known alloys, such as ZIRCALOY-2, are indexed under the trade name; cross references from each component of the alloy to the trade name appear in cumulative indexes.

Multicomponent systems in which nonmetallic elements are present in large percentage and which are commonly referred to as systems or mixtures are indexed in a manner similar to alloys.

Example: A tungsten–silicon preparation is indexed as

```
TUNGSTEN ALLOYS AND SYSTEMS
  SI--W, ...
SILICON SYSTEMS
  SI--W, ...
```

Multicompound systems and mixtures of inorganic compounds are indexed under the subject heading for each component compound; the modifiers begin with an alphabetical listing of compound formulas.

Example: A lead titanate–lead zirconate mixture is indexed as

```
LEAD TITANATES
  PbTiO₃--PbZrO₃
LEAD ZIRCONATES
  PbTiO₃--PbZrO₃
```

Mixtures of organic compounds are indexed under subject headings for each component of the mixture; the modifiers begin with an alphabetical listing of compound names.

Example:

```
ACETIC ACID
  acetic acid--BF₃, ...
BORON FLUORIDES
  acetic acid--BF₃, ...
```

Example:

```
BENZENE, CHLORO-
  bromophenol--chlorobenzene, ...
PHENOL, BROMO-
  bromophenol--chlorobenzene, ...
```

A mixed system of compounds and elements is indexed by a combined form of the preceding conventions; e.g., a dispersion of copper and alumina would be indexed as

```
ALUMINUM OXIDES
  Al₂O₃--Cu, ...
COPPER ALLOYS AND SYSTEMS
  Al₂O₃--Cu, ...
```

If modifiers for alloys and systems are included with other modifiers under the same subject heading, they are filed last.

Example:

```
CARBON SYSTEMS
  deposition on nuclear fuel
    particles
  molecular structure of
  neutron total cross section for
  sorptive properties for xenon
  Young's modulus for
  Al--C--Cr, superconductivity in
  B--C, phase studies for
  C--U--Zr, fabrication and
    physical properties of
```

Nomenclature of High Energy Physics

Information on particle-particle events is indexed under subject headings for the specific particles involved. The modifier file word *interactions* is followed by the specific interaction written in symbolic form. Particle nomenclature and symbols follow that of the Particle Data Group published in *Review of Particle Properties* (latest revision). For consistency the incident particle is always written first. The mass (in MeV) of a resonance state is included in parentheses after the symbol to avoid ambiguity. Hyperfragments are indicated in modifiers as in the following examples: $\Lambda\text{-He}^5$, $\Sigma\text{-H}^3$, $\Lambda\Lambda\text{-Be}^{10}$. The superscript on the right indicates the total number of baryons in the composite system.

Examples:

```
MESONS (π⁻)
  interactions π⁻ + p → Λ + K⁺ + π⁻ at 6 GeV/c in
    hydrogen bubble chamber, ΛK(1700) enhancement
    in, (E)
BARYONS, RESONANCE (Δ)
  production of Δ⁺⁺(1236) and Δ⁰(1236) from K⁻ +
    p → K⁻ + p + π⁺ + π⁻ interactions at 2.63 and
    2.70 GeV/c, (E)
HYPERNUCLEI
  binding energy of ΛΛ-He⁶, three-body α--Λ--Λ
    model for
```

Subject headings are also provided for specific models and theories.

Examples:

```
ELEMENTARY PARTICLE MODELS
  quark, hadron total cross sections in,
    numerical analysis of
CURRENT ALGEBRA
  PCAC hypothesis for A₁ and rho dominance in π →
    e + ν + γ decay
REGGE POLE THEORY
  predictions for polarization in K⁻ + p → anti
    K⁰ + n, π⁻ + p → π⁰ + n, and π⁻ + p → eta + n
    interactions at high energies
SYMMETRY GROUPS
  SU(2) x SU(4) intermediate-coupling model for
    nucleon and hyperon isobars
```

Nomenclature of Reactor Technology

Subject headings for reactors are of three types:

(1) Specific reactors, e.g., ARGONNE RESEARCH REACTOR, SAXTON POWER REACTOR

(2) Reactors having a common physics or engineering characteristic, e.g., REACTORS, FAST; REACTORS, ORGANIC-COOLED; REACTORS, PRESSURIZED-WATER

(3) Reactors having a common purpose, e.g., REACTORS, POWER; REACTORS, RESEARCH

Information on specific reactors, type (1), is indexed under the one specific subject heading. Information on classes or types of reactors, types (2) (characteristics) and (3) (purpose), is indexed under all applicable headings. For example, information on a heavy-water-moderated organic-cooled power reactor is indexed under REACTORS, HEAVY WATER-MODERATED; REACTORS, ORGANIC-COOLED; and REACTORS, POWER.

Subject headings exist for selected reactor components, e.g., REACTOR FUEL ELEMENTS. When applicable, headings for components are indexed even though they may have been included in a modifier under a type (2) or (3) heading. The materials in reactor components are indexed when the information is peculiar to the material.

Modifier file words under reactor headings are of two primary types: one type expresses reactor characteristics, e.g., reactivity; the other, components, e.g., control rod. If no subject heading appears for a reactor component, the heading REACTORS is used, and the component is used as the modifier file word.

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If published proceedings are received after the receipt of individual papers, the complete proceedings will be abstracted and the abstract number will appear in this index with the base CONF number.

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